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TOME 184

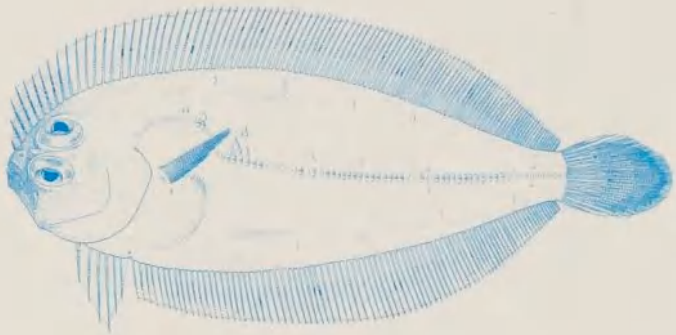
2000

Résultats des Campagnes MUSORSTOM

Volume 21

Coordonné par

Alain CROSNIER



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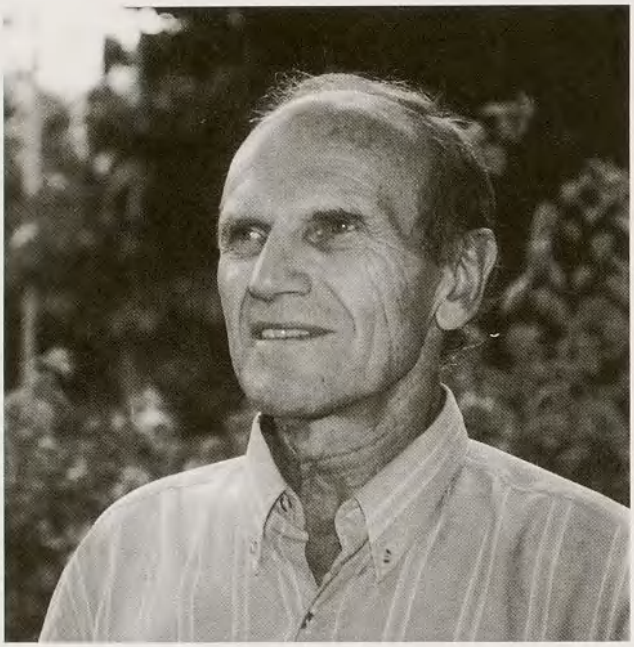

Ce volume des Résultats des Campagnes MUSORSTOM *est dédié à René GRANDPERRIN, directeur de recherches de l'IRD, qui prend sa retraite en l'an 2000 après 35 années de recherches océanographiques presque entièrement consacrées au Pacifique Sud, en Nouvelle-Calédonie et à Vanuatu. Membre du Comité de Pilotage du "programme d'évaluation des ressources sous-marines de la zone économique de Nouvelle-Calédonie" et responsable de la partie halieutique de ce programme, directeur du programme "monts sous-marins" consacré à l'étude faunistique des pentes récifales externes et des monts sous-marins et à l'évaluation de leurs potentialités halieutiques, René GRANDPERRIN a toujours soutenu le programme MUSORSTOM et est intervenu chaque fois qu'il convenait d'en faciliter l'exécution.*

Sa qualification pour les tâches dont il était responsable, sa remarquable conscience professionnelle, son dévouement discret et efficace envers ceux travaillant avec lui, sa courtoisie constante, font unanimenent regretter son départ.

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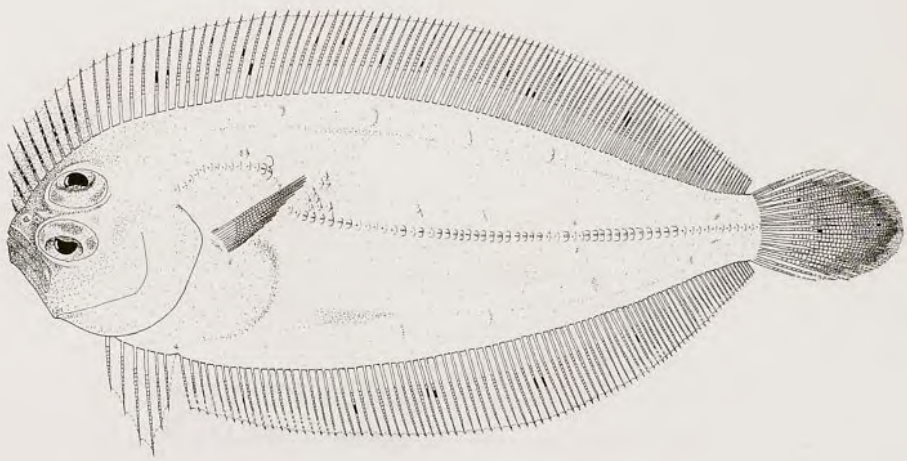
Volume 21



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ZOOLOGIE

Résultats des Campagnes MUSORSTOM

Volume 21

Coordonné par

Alain CROSNIER

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La campagne MUSORSTOM 10 dans l'archipel des îles Fidji. Compte rendu et liste des stations

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RÉSUMÉ

La campagne MUSORSTOM 10, réalisée à bord du N. O. *"Alis"*, s'est déroulée dans les eaux des Fidji, du 5 au 19 août 1998. Quatre-vingt-deux opérations de dragages et de chalutages ont eu lieu dans les zones bathyale supérieure et circalittorale de l'île de Vitu Levu et dans la zone de Bligh Water. L'essentiel des stations réalisées dans Bligh Water montre des fonds de vase, généralement parsemés de pierres ponces. Des fonds durs ont été rencontrés dans la zone de Beqa Channel. Les peuplements présentent une diversité spécifique plus faible qu'en Nouvelle-Calédonie, en particulier dans les groupes d'invertébrés fixés (spongiaires, stylastérides, crinoïdes).

ABSTRACT

The MUSORSTOM 10 Cruise in the Fijian Archipelago. Report and list of stations.

The MUSORSTOM 10 cruise, using the R.V. *"Alis"*, was carried out in the Fijian Archipelago during 5-19 August 1998. A total of 82 samples were collected by dredging and trawling from the upper bathyal zone and in the circalittoral depths, on the outer reef slopes of Vitu Levu and from Bligh Water. The bottom of Bligh Water is muddy and covered with pumice stones. Hard bottoms were sampled in the Beqa Channel. The invertebrate biodiversity of the benthic communities sampled is much lower than those sampled from the New Caledonian area, especially sessile epifaunal groups like sponges, stylasterine hydrocorals (Cnidaria, Stylasterina) and crinoids.

RICHER DE FORGES, B., NEWELL, P., SCHLACHER-HOENLINGER, M., SCHLACHER, T., NATING, D., CÉSA, F. & BOUCHET, P., 2000. — La campagne MUSORSTOM 10 dans l'archipel des îles Fidji. Compte rendu et liste des stations. *In* : A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 21. *Mémoires du Muséum national d'Histoire naturelle*, **184** : 9-23. Paris ISBN-2-85653-526-7.

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INTRODUCTION

La campagne MUSORSTOM 10 s'est déroulée du 5 au 19 août 1998 à bord du N.O. *"Alis"* dans l'archipel des îles Fidji. Cette campagne fait partie d'un programme destiné à explorer la faune benthique de la zone bathyale supérieure dans l'Indo-Ouest Pacifique. Un récapitulatif des huit premières campagnes est présenté en introduction du compte-rendu concernant MUSORSTOM 9 aux îles Marquises (RICHER DE FORGES & LABOUTE, 1998; RICHER DE FORGES *et al.*, 1999).

Les observations bathymétriques et géographiques ainsi que les résultats taxonomiques concernant l'ensemble de ces campagnes sont stockés dans des bases de données informatisées, tenues à jour au Centre IRD (anciennement ORSTOM) de Nouméa. La plus grande partie des résultats zoologiques et biogéographiques ont été publiés dans la série "Résultats des Campagnes MUSORSTOM" qui, dans ses 20 premiers volumes traite de 4587 espèces parmi lesquelles 1324 étaient nouvelles pour la Science et ont nécessité la création de 126 genres ou sous-genres nouveaux. Cette importante amélioration des connaissance sur les faunes de profondeur de l'Indo-Ouest Pacifique tropical est le résultat d'une collaboration active d'un réseau international de taxonomistes (24 nations, 92 institutions de recherche et 181 chercheurs).

Bien que l'analyse de ce vaste ensemble de données originales soit encore en cours, certaines remarques peuvent être faites (RICHER DE FORGES, 1998) :

— les profondeurs bathyales (200-2000 m) sont très discontinues et de nombreuses zones demeurent inexplorées (Fig. 1);

— dans l'Indo-Ouest Pacifique, ces profondeurs présentent une richesse spécifique élevée. Dans l'ensemble de la zone étudiée, la faune était en grande partie inconnue avec 28,9 % d'espèces nouvelles; pour la Nouvelle-Calédonie, 60,7 % des 1619 espèces d'invertébrés actuellement étudiées étaient nouvelles;

— les faunes benthiques de la "province Indo-Pacifique" sont différentes d'un archipel à l'autre et la répartition géographique de nombreuses espèces est plus restreinte que prévue dans les travaux de biogéographie (EKMAN, 1953; BRIGGS, 1974). Ainsi, la faune récoltée dans la partie nord de l'archipel de Vanuatu pendant la campagne MUSORSTOM 8 se révèle bien différente de celle de Nouvelle-Calédonie, distante de moins de 300 km;

— dans plusieurs groupes zoologiques les espèces considérées comme archaïques ou reliques sont particulièrement abondantes (Spongiaires, Brachiopodes, Echinodermes, Mollusques, Crustacés...) ;

— les sommets des monts sous-marins sont particulièrement riches en espèces et en biomasse et semblent favoriser l'endémisme. Cette observation met en évidence la très grande vulnérabilité de certaines espèces benthiques qui ont des aires de répartitions limitées à quelques km^2. Cette vulnérabilité est encore accrue du fait d'une

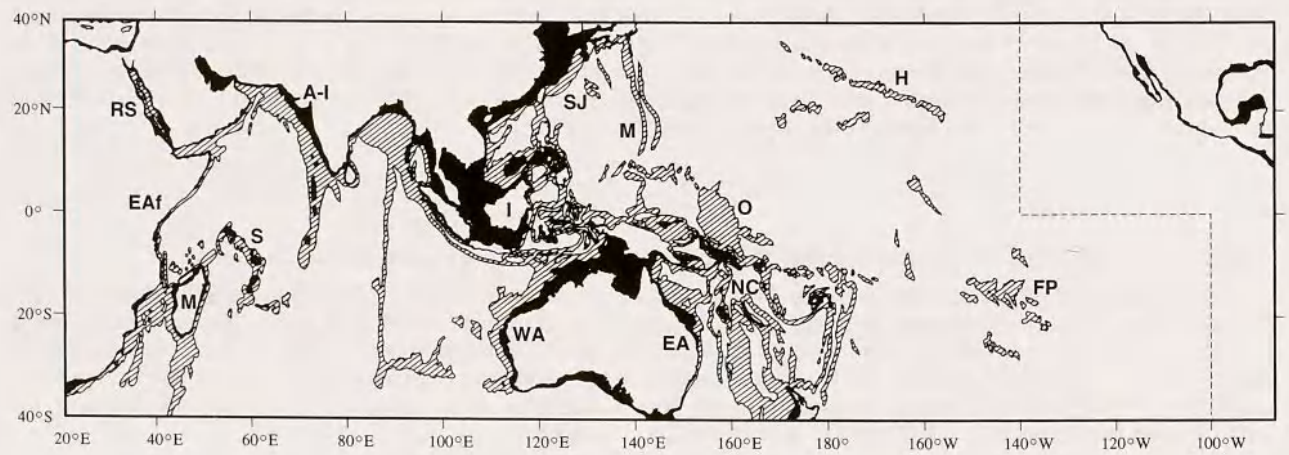

Fig. 1. — Cartographie des profondeurs bathyales de l'Indo-Ouest Pacifique. En noir, les fonds de 0 à 200 m; en hachures, les zones de profondeurs bathyales (200-2000 m). Carte réalisée par RICHER DE FORGES (1998) à partir des données d'altimétrie satellitaires publiées, sous forme d'une carte au 1/40 millionième, par SLOSS (1994).
A-I : Arabo-Indian; EA : East Australia; EAf : East Africa; FP : French Polynesia; H : Hawaii; M : Marianas, Madagascar; NC : New Caledonia; O : Ontong Java; RS : Red Sea; S : Seychelles; SJ : South Japan.

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croissance lente de ces organismes de profondeur (VACELET *et al.*, 1992; KOSLOW & EXON, 1995; ZEZINA, 1997; KOSLOW & GOWLETT-HOLMES, 1998; RICHER DE FORGES *et al.*, 1998).

GÉNÉRALITÉS

L'archipel des îles Fidji s'étend entre 16 et 20°S et 177°E à 178°W. Il est constitué d'environ 300 îles et îlots dont les plus grands sont Vitu Levu et Vanua Levu qui ont des superficies respectives de 10400 km^2 et 5538 km^2 et qui culminent à 1323 m et 1111 m. Ces îles, d'origine volcanique, sont entourées de formations coralliennes qui délimitent par endroits des lagons vastes et profonds (ANTHEAUME & BONNEMAISON, 1988; CHANDRA & MASON, 1998).

L'île de Vitu Levu comporte trois grands fleuves dont le plus important est, au sud-est, la Rewa River (Wai Levu), qui draine un bassin versant d'environ 3000 km^2. Il s'agit du plus grand cours d'eau de tout le Pacifique insulaire (Papouasie Nouvelle-Guinée exceptée). Le débit de la Rewa River a été évalué pour la première fois par DANA (1872) à 236 m^3/s (MOSELEY, 1879). Des données plus récentes font état de débits moyens mensuels en 1998 (mesurés à Navolau) variant de 277 m^3/s en janvier à 29 m^3/s en août. Ce débit aurait atteint 9000 m^3/s pendant le cyclone Kina en janvier 1991 (GOUYET, com. pers.). Son delta actuel s'est formé pendant l'Holocène et le transport solide de ce fleuve est estimé à 3200 tonnes/km^2/an (NUNN, 1998).

D'après les vestiges archéologiques et en particulier les poteries, il semble que l'archipel des îles Fidji ait été peuplé par les hommes il y a plus de 3000 ans (IRWIN, 1992; GRAVELLE, 1996; KIRCH, 1997). Bien avant l'arrivée des occidentaux, de puissantes chefferies occupaient toutes les îles et avaient déjà profondément modifié l'environnement (KIRCH & HUNT, 1997). Les îles Fidji (Feedjee) furent révélées au monde occidental par le navigateur hollandais Abel TASMAN en 1643 (DUNMORE, 1991). Au cours de ses périples dans le Pacifique, le Capitaine COOK fît escale longuement (mai-juillet 1777) aux "îles de l'Amitié" (Tonga) mais évita les Fidji alors réputées très dangereuses pour leurs féroces cannibales (COOK, 1980; FROST, 1998). L'un des premiers contacts entre les civilisations est resté célèbre. Il s'agit du passage du Capitaine William BLIGH (qui avait été aux Tonga avec COOK à bord du *"Resolution"*) en 1789 dans la mer qui porte aujourd'hui son nom, Bligh Water, à la suite de la mutinerie à bord de son bateau, la *"Bounty"*.

CONDITIONS HYDROCLIMATIQUES. — Les îles Fidji sont soumises à un climat maritime tropical. Les vents alizés de Sud-Est apportent des pluies qui sont donc plus marquées sur le versant Est des îles (JONES & PINHEIRO, 1997; CHANDRA & MASON, 1998). La saison des pluies s'étend de novembre à avril et la pluviosité moyenne annuelle est de 3100 mm à Suva. A Nandi, situé sur le versant sous le vent de Vitu Levu, la pluviosité moyenne n'atteint pas 2000 mm/an. La température moyenne à Suva est de 25°C mais dépasse fréquement 30°C en été (décembre-mars) et descend occasionnellement en dessous de 20°C en hiver (juillet-août).

Les caractéristiques hydrologiques de cette partie du Pacifique sud-ouest ont été décrites par DELCROIX et HENIN (1989). Ces auteurs décrivent les variations saisonnières et interannuelles, mettant en évidence l'événement ENSO (El Niño Southern Oscillation) très fort de 1982-83. Les températures de surface de l'océan sont comprises entre 25 et 30°C avec une moyenne annuelle en surface de 27,5°C. En temps ordinaire (hors El Niño), la température minimale en surface s'observe en août et la salinité minimale en mars, environ trois mois après le maximum de précipitations. Entre 300 et 400 m de profondeur, les températures fluctuent, d'une année à l'autre, entre 10 et 12°C. La salinité moyenne annuelle observée aux Fidji est de 35,1 ‰. L'amplitude maximale des vents alizés de SE est de 6-7 m.s^{-1}.

Dans la zone de Bligh Water, les sondes XBT lancées donnèrent les indications suivantes en août 1997 : 24°C en surface, thermocline à environ 100 m de profondeur et 8°C à 550 m de profondeur.

Pendant les grandes fluctuations climatiques du Quaternaire, le niveau marin a considérablement varié (HOPLEY, 1982; PAULAY, 1990, 1997; CABIOCH *et al.*, 1996; NUNN, 1994, 1998). Les niveaux les plus bas furent situés entre 100 et 150 m en dessous du niveau actuel. La quasi-disparition des lagons durant ces niveaux bas a dû réduire la répartition géographique des espèces marines typiquement lagonaires. D'après PAULAY (1990), la zone profonde de Bligh Water aurait pu jouer le rôle de refuge pour cette faune lagonaire et particulièrement pour les bivalves de

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fonds meubles. Il semble également que des variations de température relativement rapides (1500 ans) de plus de 5°C aient eu lieu dans ces latitudes tropicales (BECK *et al.*, 1997).

HISTOIRE GÉOLOGIQUE DES ÎLES FIDJI

D'importants travaux de géophysique et de géologie marine ont eu lieu dans le sud-ouest Pacifique, de mars à juin 1982, à bord du R.V. *"Kana Keoki"*, sous l'égide de la CCOP/SOPAC. Les résultats obtenus concernent la bathymétrie, la nature des fonds et des datations des principales îles volcaniques. L'essentiel de ces résultats sont regroupés dans l'ouvrage de BROCHER (1985). Les grands traits de l'histoire géologique des îles Fidji ont été relatés par RODDA (1994). Les plus anciennes roches volcaniques des îles Fidji sont trouvées sur Vitu Levu et datent de l'Éocène supérieur soit environ 34 M.A. (COULSON, 1974; MYERS, 1985; RODDA, 1994). Depuis, de nombreux épisodes volcaniques se sont succédés jusqu'à la période actuelle, les roches s'étant souvent formées en milieu marin.

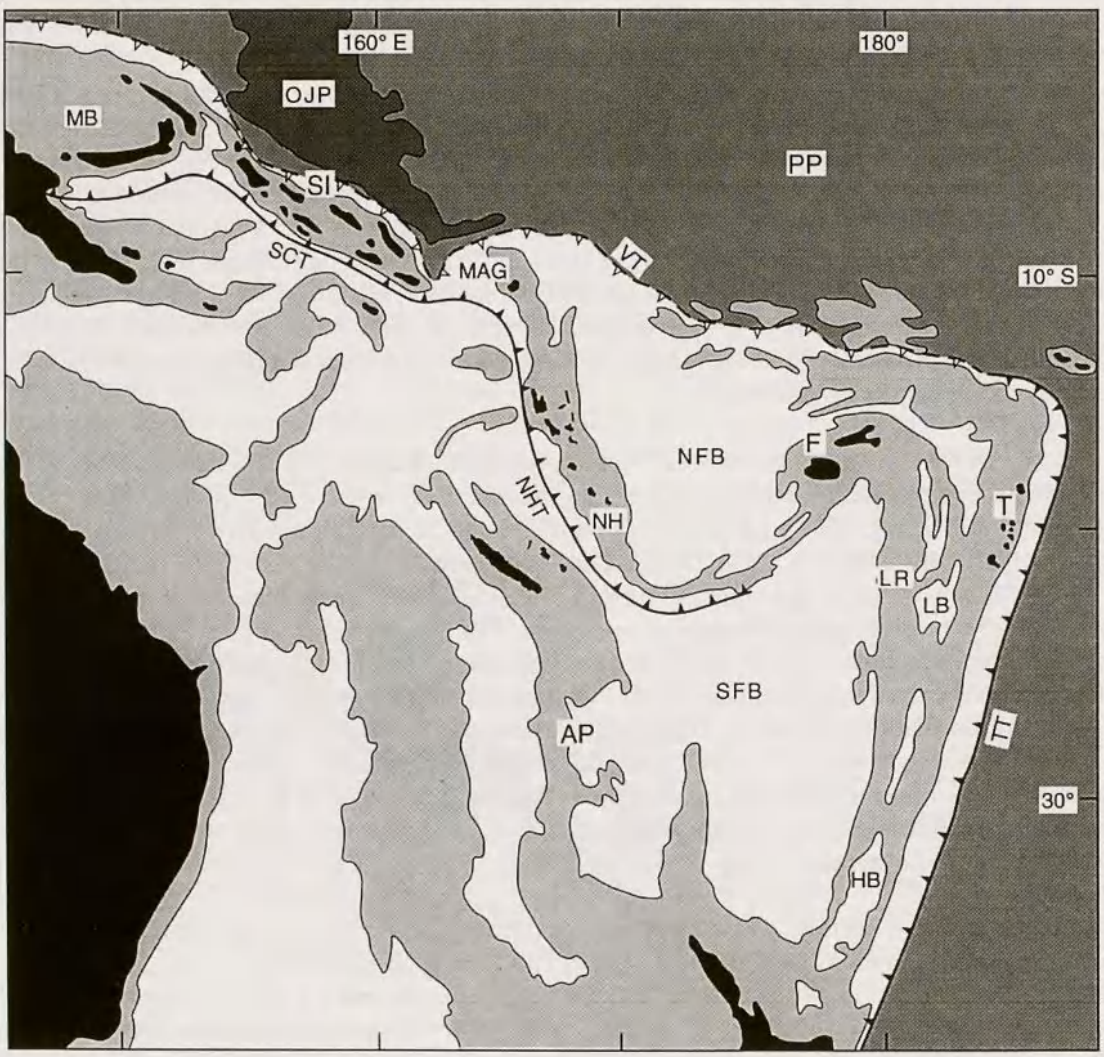

FIG. 2. — Géomorphologie du Pacifique sud-ouest montrant les grands traits structuraux, plaques, fosses de subduction (d'après AUZENDE *et al.*, 1996).

Source : MNHN, Paris

Les mouvements tectoniques complexes de la bordure orientale de la plaque australo-indienne ont été décrits à la suite de nombreux travaux de géologie marine (SPRINGER, 1982; LEWIS, 1993; AUZENDE *et al.*, 1995). Le groupe principal des îles Fidji, Vitu Levu et Vanua Levu, est situé juste à l'angle oriental de cette plaque et faisait partie de l'alignement Nouvelles-Hébrides - Fidji - Tonga lors de la période active de la "fosse de Vitiaz", avant l'ouverture du Bassin nord fidjien, il y a 10 M.A. (Fig. 2).

CONNAISSANCES ANTÉRIEURES SUR LA FAUNE MARINE DES ÎLES FIDJI

WIENS (1962) attire l'attention sur le fait que la faune marine des îles Fidji est encore typique du "Melanesian Plateau" mais diffère nettement de celle des îles Samoa, pourtant toutes proches, qui font partie de l'ensemble Polynésien.

L'expédition du H.M.S. *"Challenger"* réalisa des prélèvements benthiques dans l'archipel des Fidji entre le 24 juillet et le 11 août 1874 (MOSELEY, 1879; SPRY, 1880; LINTAKER, 1972). Les premiers dragages furent réalisés près de l'île Matuka, au SE de Vitu Levu, par 585 m et un spécimen de nautile (*Nautilus pompilius*) fut capturé ainsi que de nombreux spécimens de *Polycheles*. Les îles de Kadavu et Ovalau furent ensuite explorées.

La **faune bathyale** n'était donc connue, avant MUSORSTOM 10, pratiquement que d'après l'étude du matériel récolté au cours des 3 stations profondes du *"Challenger"* près de Matuka et Kandavu (19°09,35'S-179°41,50'E; 19°07,50'S-178°19,35'E; 19°05,50'S-178°16,20'E).

HARPER et SMITH (1989) donnent quelques indications sur les 32 opérations de dragages réalisées dans le Sud-Est de Vitu Levu et sur la Ride de Lau, à bord du F.N.S. *"Babale"*, dans le but de rechercher des "coraux précieux" du genre *Corallium*. Dix-huit stations ramenèrent des échantillons qui furent confiés à l'Université d'Hawaii. Les quelques organismes (spongiaires, gorgones, échinodermes, scléractiniaires) signalés dans ce rapport (GRIGG, 1996) ne semblent pas avoir fait l'objet de publications.

De fait, au moment de la campagne MUSORSTOM 10, les faunes profondes de mollusques de l'archipel fidjien restaient pratiquement *terra incognita* : les trois dragages réalisés par le *"Challenger"*, en 1874, entre 385 et 1115 m de profondeur avaient fait connaître en tout et pour tout six espèces de gastéropodes, toutes nouvelles à l'époque, et aucun représentant des autres classes de mollusques. Sur ces six espèces, *Bolma henica* et *Cerithium matukense* se sont avérées avoir une vaste répartition Indo-Pacifique, et *Bursa fijiensis* n'a été que très récemment redécouverte en Nouvelle-Calédonie (BEU, 1998); par contre, *Fusus libratus*, *Gaza daedala* et *Clathurella compsa* restent, 125 ans après, connues uniquement par les récoltes du *"Challenger"* devant Kandavu et Matuka. Après le *"Challenger"*, il ne se passe plus rien pendant plus de cent ans, hormis la découverte, fortuite, d'un nouveau pleurotomaire sur la Ride de Lau par le navire néo-zélandais *"Tangaroa"* en 1980 (BOUCHET & MÉTIVIER, 1982). Cependant, l'événement le plus marquant des récentes décennies est la découverte de communautés biologiques associées aux manifestations hydrothermales dans les bassins de Lau et nord-fidjien (DESBRUYÈRES *et al.*, 1994). Cette découverte a entrainé la réalisation de campagnes de prospection par submersibles (campagnes franco-japonaise STARMER 2 et française BIOLAU) et par benne télécommandée (campagne allemande du *"Sonne"*). La faune malacologique de ces sites, relativement bien inventoriée; comprend une vingtaine d'espèces de gastéropodes (BOUCHET & WARÉN, 1991; WARÉN & BOUCHET, 1993; OKUTANI & OHTA, 1993; BECK, 1996) et plusieurs grands bivalves (MÉTIVIER & COSEL, 1993; COSEL *et al.*, 1994), dont les affinités biogéographiques sont à rechercher dans le bassin de Manus et le bassin des Mariannes.

S'y ajoutent quelques spécimens benthiques récoltés lors de l'étude des sources hydrothermales du Bassin de Lau par la campagne BIOLAU ou les repérages qui ont précédé tels que la campagne du R.V. *"Sonne"* en 1987 (YAMAGUCHI & NEWMAN, 1990; BABA & TÜRKAY, 1992).

La **faune benthique littorale** et lagonaire des îles Fidji n'est guère mieux étudiée. VERON (1995) dans son ouvrage de biogéographie des scléractiniaires constructeurs, mentionne 60 genres et 250 espèces aux Fidji. A l'occasion d'un Symposium sur la biodiversité des zones littorales des îles du Pacifique, un bilan des connaissances avait été présenté par les spécialistes de certains groupes zoologiques (MARAGOS *et al.*, 1995). Pour

Source : MNHN, Paris

la région des îles Fidji, les données proviennent soit du *"Challenger"*, soit de quelques petites récoltes occasionnelles plus récentes. En 1965, le R.V. *"Te Vega"* collecta un peu de faune marine littorale de Vitu Levu, améliorant ainsi les rares données sur la faune marine de cette région. Une liste de 41 espèces de spongiaires actuellement signalées des Fidji est donnée par KELLY-BORGES et VALENTINE (1995). Vingt-quatre espèces de Polychètes seraient signalées (BAILEY-BROCK, 1995). Pour les Crustacés, l'étude réalisée par MYERS (1985) sur les amphipodes Gammaridea des îles Fidji a permis de récolter 77 espèces dont 40 % étaient nouvelles. Les affinités géographiques observées par cet auteur sont plutôt avec Hawaii, l'ouest du Pacifique (Indonésie) ou même l'océan Indien qu'avec la Polynésie.

La faune malacologique marine des Fidji est sans doute l'une des mieux connues de tous les archipels du Pacifique. Cette situation est essentiellement le résultat du travail d'un seul homme, Walter O. CERNOHORSKY, qui pendant 15 ans fut employé comme cadre par l'Emperor Gold Mining Co. à Vatukoula (Viti Levu), avant de devenir en 1969 curator of molluscs à l'Auckland Institute and Museum. CERNOHORSKY a publié de nombreuses monographies régionales sur les gastéropodes des Fidji (CERNOHORSKY, 1964a, 1964b, 1965, 1967b, 1967c, 1968, 1969, 1971), et ses révisions contiennent également une foule de données géographiques nouvelles concernant l'archipel (CERNOHORSKY, 1976, 1984, 1991). Ses trois ouvrages d'identification des faunes du Pacifique (CERNOHORSKY, 1967a, 1972, 1978) demeurent des classiques, et plus de la moitié des 600 espèces traitées dans le deuxième volume (CERNOHORSKY, 1972) sont illustrées avec des spécimens des Fidji. Dans tous ses travaux, CERNOHORSKY a focalisé son intérêt et ses efforts sur les espèces littorales des familles qui intéressent les collectionneurs : les micromollusques, les espèces subtidales accessibles seulement par dragage et en plongée; les bivalves restent peu ou pas inventoriés.

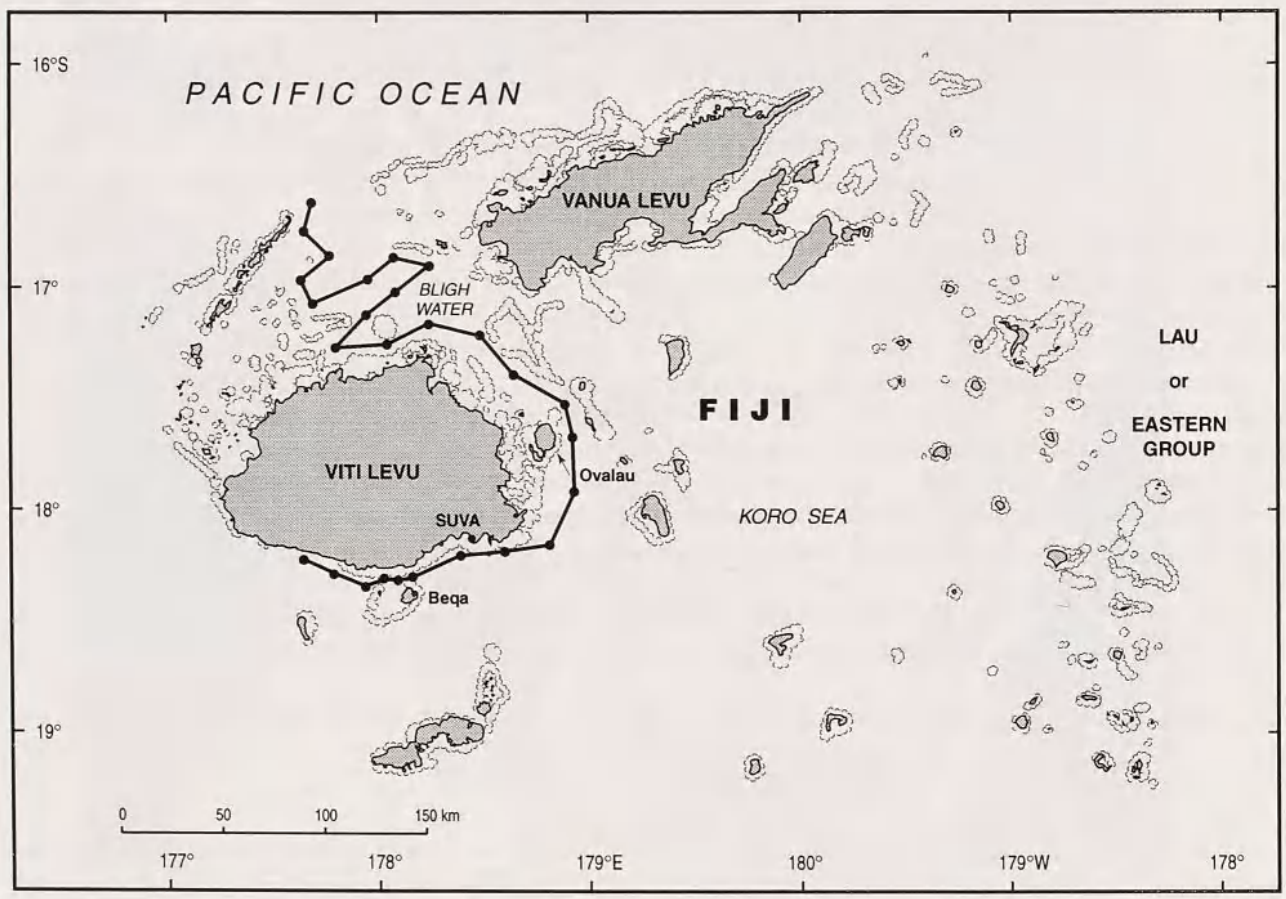

FIG. 3. — L'itinéraire de la campagne MUSORSTOM 10 dans l'archipel des îles Fidji.

Source : MNHN, Paris

PARKINSON (1982) dans une liste préliminaire des coquillages potentiellement exploitables des îles Fidji, signale la capture de *Cypraea valentia* sur les côtes de l'île de Kadavu. Cette espèce rare a été retrouvée au cours de MUSORSTOM 10 à l'embouchure de la Rewa River, sur l'île de Vitu Levu. Un récent travail d'inventaire des gastéropodes Conidae des Fidji, d'après une compilation bibliographique, fait état de 99 espèces (SEETO, 1998).

L'étude biogéographique des échinodermes de l'Indo-Pacifique de CLARK et ROWE (1971) signale de nombreuses espèces des îles du Pacifique Sud mais ne renseigne pas spécialement sur celles des îles Fidji.

Pour les poissons, KULBICKI et RIVATON (1997) recensent, d'après la littérature, 822 espèces des îles Fidji. D'après les compilations d'inventaires non publiés, il y aurait actuellement 960 espèces connues des Fidji (KULBICKI, com. pers.).

Quelques travaux d'écologie ont eu lieu dans le lagon du récif de l'*"Astrolabe"* sur l'île de Kadavu. Ils ont été effectués de façon quantitative avec une benne de 0,1 m^2 ou en plongée sous-marine et apportent peu d'indications sur la composition spécifique (CLAVIER *et al.*, 1996; NEWELL *et al.*, 1996; NEWELL *et al.*, 1997; NEWELL & CLAVIER, 1997; SCHLACHER *et al.*, 1998).

DÉROULEMENT DE LA CAMPAGNE MUSORSTOM 10

La campagne MUSORSTOM 10 avait pour objectif l'échantillonnage de la faune benthique de la zone bathyale supérieure des îles Fidji, de 200 à 1500 m (cf. liste des stations en annexe; Fig. 3-4).

Le navire océanographique de l'ORSTOM, N.O. *"Alis"*, basé à Nouméa, était déjà dans l'archipel des Fidji depuis un mois et avait effectué deux autres campagnes concernant les effets anthropiques en zone littorale (SUVA 1) et les paléoclimats (PALEOFIJI). La campagne MUSORSTOM 10 débuta le 4 août au soir au départ de Suva et la première opération de dragage (DW 1308) eut lieu au nord-ouest de l'île d'Ovalau dans le chenal sud de Bligh Water. Les fonds de ce chenal, d'une profondeur de 700 à 900 m, sont composés de vases argileuses grises contenant de nombreuses coquilles de ptéropodes. Dès les premiers chalutages, nous remontions des pierres ponces et des bois coulés, très abondants dans les eaux fidjiennes à proximité des grandes îles hautes. Ces substrats particuliers permettent la présence de faunes associées : des pagures symétriques de la famille des Pylochelidae (*Pylocheles incisus, Cheiroplatea pumicicola*), foreurs dans les bois, les ponces et parfois les éponges siliceuses (FOREST, 1987) et, profitant des substrats organiques, des amphipodes, des chitons (*Leptochiton*) et des gastéropodes cocculiniformes (RICHER DE FORGES *et al.*, 1996). Les spécimens de Pylochelidae récoltés appartiennent à l'espèce *Cheiroplatea pumicicola* Forest, 1987 qui n'était jusqu'alors connue que par une trentaine de spécimens des îles Kermadec (29°S-177°W).

Il faut signaler également la découverte, à plusieurs reprises de becs de céphalopodes portant des gastéropodes du genre *Bathysciadium*.

Bligh Water. — La zone dite de Bligh Water est très particulière (WINGFIELD *et al.*, 1977). Il s'agit d'une sorte de "mer intérieure" située entre les deux îles principales, Vitu Levu et Vanua Levu. Elle est presque entièrement bordée par les barrières coralliennes délimitant les lagons de ces deux îles et sa profondeur atteint près de 1000 m en son centre. Les chenaux d'accès à Bligh Water, situés au nord et au sud, sont toutefois très profonds (>600 m) et ne présentent donc pas de seuils qui auraient pu y confiner une faune relique. Les études sismiques réalisées dans cette mer ont montré une épaisseur de sédiments d'environ 2800 m (MAUNG & EDEN, 1983).

Pratiquement la totalité des opérations dans Bligh Water s'est déroulée sur des fonds vaseux entre 600 et 900 m de profondeur. Les peuplements caractéristiques sont composés de gros oursins irréguliers, de mollusques Pectinidae du genre *Propeamusium*, de crustacés des genres *Platymaia* et *Glyphocrangon*, de poissons de la famille des Macrouridae. Des spécimens du gastéropode Volutidae *Calliotectum egregium* ont été trouvés.

Sur les pentes récifales externes délimitant les contours de Bligh Water, entre 300 et 500 m de profondeur, les fonds sont plus sablo-vaseux et présentent les organismes suivants : gastéropodes Xenophoridae, Crustacés décapodes des genres *Munida*, *Munidopsis*, *Hexaplax, Ethusina*, des crustacés cirripèdes pédonculés, poissons Scorpaenidae, Triglidae, Bothidae.

Source : MNHN, Paris

FIG. 4. — Les participants à la campagne MUSORSTOM 10 : de gauche à droite, Frédéric CÉSA, Dako NATING, Philippe BOUCHET, Bertrand RICHER DE FORGES, Monika SCHLACHER-HOENLINGER, Peter NEWELL (Photo B. RICHER DE FORGES).

Dans les fonds de moins de 300 m, on remarque l'abondance des crustacés décapodes brachyoures Goneplacidae (*Carcinoplax, Hexapus, Psopheticus*) et Leucosiidae (*Iphiculus*) et dans certaines stations plus envasées de brachyoures Retroplumidae, Palicidae et Raninidae (*Lyreidius, Raninoides*). Les crevettes pénéides du genre *Metapenaeopsis* sont également fréquentes.

Signalons la présence entre 300 et 400 m d'espèces connues jusqu'alors uniquement de Nouvelle-Calédonie et du sud de Vanuatu : c'est le cas du crabe Majidae *Oxypleurodon orbiculatus*.

Rewa Roads. — Quelques opérations furent réalisées en face de l'estuaire de la Rewa River, dans la zone dénommée Rewa Roads sur les cartes, entre 80 et 160 m de profondeur (dont trois opérations de chalutages en présence de l'Ambassadeur de France et du Director of the National Trust of Fiji). Les fonds de vases noires y sont très riches en débris végétaux avec une faune associée très diversifiée : mollusques Muricidae, une dizaine d'espèces de nudibranches, bivalves du genre *Abra* et Scaphopodes, crustacés *Metapenaeopsis, Raninoides, Arcania, Myra, Macropodia* et Stomatopodes, poissons Scorpaenidae.

Beqa Channel. — La zone de Beqa Channel consiste en un étroit passage (< 5 milles) situé entre la côte sud de l'île de Vitu Levu et l'île haute de Beqa, entourée d'un vaste lagon délimité par une barrière corallienne. Le fond de ce chenal se situe vers 240 m de profondeur et présente des zones rocheuses et de sables grossiers, conséquence des forts courants qui y règnent. Les organismes les plus abondants dans ce type de fonds sont, les mollusques du genre *Liotia*, des crustacés *Munida* et *Chirostylus*, des crabes Dynomenidae, Xanthidae, des Scyllariidae, de nombreux pagures Pylochelidae forant des roches calcaires, des Brachiopodes. Signalons la découverte de la volute *Lyria planicostata* qui était jusqu'alors connue uniquement de Vanuatu et plus à l'ouest (LADD, 1982).

Au cours de la campagne MUSORSTOM 10, des gonades ont été prélevées sur certaines espèces de Crustacés afin d'en décrire les spermatozoïdes et d'utiliser ces nouveaux caractères pour préciser leur position phylogénétique

Source : MNHN, Paris

(JAMIESON *et al.*, 1995). Les prélèvements, actuellement à l'étude, ont porté sur : Polychelidae (*Polycheles typhlops*), Pylochelidae (*Cheiroplatea pumicicola*), Lithodidae (*Lithodes* sp.), Galatheidae (*Bathymunida* sp.), Leucosiidae (*Arcania* sp., *Iphiculus spongiosus*, *Myra* sp.).

CONCLUSIONS

La connaissance de la faune de profondeur des îles Fidji s'accroît considérablement avec les récoltes de la campagne MUSORSTOM 10 et ces résultats vont combler une vaste lacune géographique. Les remarques préliminaires qui peuvent être faites avant l'étude détaillée par les spécialistes de chaque groupe sont les suivantes :

— la faune bathyale des Fidji est nettement plus pauvre en espèces que celle de Nouvelle-Calédonie, mais plus riche que celle de Polynésie française et en particulier que celle de l'archipel des îles Marquises (RICHER DE FORGES *et al.*, 1999);

— certains groupes fixés tels que les stylastérides, les crinoïdes pédonculés et même les spongiaires semblent rares et peu diversifiés. Il faut toutefois moduler ces remarques car la majorité des zones échantillonnées présentait des fonds meubles peu favorables à ce type d'organismes.

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ANNEXES

LISTE DES PARTICIPANTS À LA CAMPAGNE MUSORSTOM 10

Chef de mission : B. RICHER DE FORGES.

Autres participants : P. BOUCHET, P. NEWELL, M. SCHLACHER, T. SCHLACHER, D. NATING, F. CÉSA.

LISTE DES STATIONS DE LA CAMPAGNE MUSORSTOM 10

(DW : drague Waren; CC : chalut à crevettes; CP : chalut à perche; CAS : casiers)

Stations	Date (1998)	Profondeur (m)	Latitude Sud	Longitude Est
DW 1308	05.08	893-897	17°32,87'	178°53,37'
CP 1309	" "	843-887	17°32,05'	178°53,24'
CP 1310	" "	700-775	17°28,97'	178°47,39'
DW 1311	" "	673-680	17°26,14'	178°41,82'
CP 1312	" "	660-666	17°24,52'	178°34,00'
CP 1313	" "	670-676	17°22,30'	178°34,10'
DW 1314	" "	656-660	17°16,15'	178°14,85'
DW 1315	06.08	480-500	17°16,18'	178°24,24'
CP 1316	" "	478-491	17°14,84'	178°21,99'
CP 1317	" "	471-475	17°11,99'	178°14,14'

Source : MNHN, Paris

CP 1318	" "	330-335	17°15,65'	178°03,45'
DW 1319	06.08	341-347	17°15,61'	178°01,88'
CP 1320	" "	290-300	17°16,78'	177°53,57'
CAS 1321	07.08	200-200	17°17,33'	177°47,68'
CP 1322	" "	210-282	17°17,10'	177°47,92'
CP 1323	" "	143-173	17°16,10'	177°45,75'
CP 1324	" "	102-104	17°17,37'	177°47,05'
CP 1325	" "	282-322	17°16,39'	177°49,80'
CP 1326	" "	265-300	17°14,26'	177°49,68'
CP 1327	" "	370-389	17°13,26'	177°51,62'
CP 1328	" "	248-277	17°16,76'	177°50,45'
DW 1329	08.08	102-106	17°19,33'	177°47,36'
CP 1330	" "	567-699	17°09,50'	177°56,32'
CP 1331	" "	694-703	17°02,45'	178°01,84'
CP 1332	" "	640-687	16°56,17'	178°07,86'
DW 1333	" "	200-215	16°50,36'	178°12,55'
DW 1334	09.08	251-257	16°51,37'	178°13,95'
CP 1335	" "	729-753	16°52,76'	178°03,05'
CC 1336	" "	797-799	16°58,05'	177°58,39'
CC 1337	" "	635-670	17°03,44'	177°47,21'
DW 1338	" "	306-315	17°05,14'	177°39,07'
DW 1339	10.08	235-252	16°59,60'	177°35,83'
DW 1340	" "	303-365	16°56,65'	177°37,92'
CP 1341	" "	500-614	16°52,51'	177°43,66'
CP 1342	" "	650-701	16°45,98'	177°39,71'
CP 1343	" "	938-940	16°38,95'	177°40,84'
CP 1344	" "	588-610	16°45,26'	177°40,53'
DW 1345	11.08	660-663	17°14,92'	178°29,50'
CP 1346	" "	673-683	17°19,63'	178°32,39'
DW 1347	" "	344-349	17°30,72'	178°39,95'
CP 1348	" "	353-390	17°30,29'	178°39,63'
CP 1349	" "	244-252	17°31,07'	178°38,79'
DW 1350	" "	198-200	17°32,46'	178°37,49'
CP 1351	" "	292-311	17°31,14'	178°39,96'
DW 1352	12.08	241-245	17°31,40'	178°39,37'
CP 1353	" "	879-897	17°30,90'	178°53,36'
CP 1354	" "	959-963	17°42,60'	178°54,98'
CP 1355	" "	302-310	17°49,54'	178°49,39'
DW 1356	" "	203-208	17°50,26'	178°47,97'
DW 1357	13.08	81-110	17°48,48'	178°46,70'
CP 1358	" "	80-120	17°48,49'	178°46,70'
DW 1359	" "	183-188	17°49,67'	178°47,78'
CP 1360	" "	402-444	17°59,57'	178°48,20'
CP 1361	" "	1058-1091	18°00,00'	178°53,71'
DW 1362	14.08	80-89	18°11,72'	178°35,46'
CP 1363	15.08	144-150	18°12,39'	178°33,01'

Source : MNHN, Paris

CP 1364	" "	80-86	18°11,95'	178°34,50'
DW 1365	15.08	295-302	18°12,73'	178°32,38'
CP 1366	" "	149-168	18°12,36'	178°33,06'
DW 1367	" "	377-423	18°10,96'	178°23,45'
CP 1368	" "	380-469	18°10,92'	178°23,47'
CP 1369	16.08	392-433	18°11,13'	178°2344'
CP 1370	" "	113-123	18°12,32'	178°33,10'
CP 1371	" "	135-151	18°12,36'	178°32,85'
DW 1372	17.08	239-248	18°18,42'	178°03,83'
DW 1373	" "	238-244	18°18,46'	178°02,13'
DW 1374	" "	259-348	18°18,53'	178°05,86'
DW 1375	" "	409-480	18°18,43'	178°07,37'
DW 1376	" "	497-504	18°18,67'	178°09,07'
DW 1377	" "	233-248	18°18,40'	178°02,47'
CP 1378	" "	240-249	18°18,42'	178°01,89'
DW 1379	" "	223-263	18°18,82'	178°00,94'
DW 1380	18.08	321-321	18°19,14'	177°59,16'
DW 1381	" "	275-430	18°17,78'	177°54,43'
DW 1382	" "	441-443	18°19,19'	177°51,68'
DW 1383	" "	230-251	18°18,40'	178°02,60'
DW 1384	" "	260-305	18°18,50'	178°05,83'
CP 1385	" "	227-284	18°18,48'	178°05,18'
CP 1386	19.08	230-344	18°18,53'	178°05,15'
CP 1387	" "	229-370	18°18,55'	178°04,86'
DW 1388	" "	313-446	18°18,53'	178°01,80'
CP 1389	" "	241-417	18°18,58'	178°04,73'
CP 1390	" "	234-361	18°18,59'	178°05,10'

Source : MNHN, Paris

Source : MNHN, Paris

2

La campagne BORDAU 1 sur la ride de Lau (îles Fidji). Compte rendu et liste des stations

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RÉSUMÉ

La campagne BORDAU 1, réalisée à bord du N. O. *"Alis"*, s'est déroulée dans les eaux des Fidji, du 22 février au 14 mars 1999. Cent dix-huit opérations de dragages et de chalutages ont eu lieu dans les zones bathyale supérieure et circalittorale des îles et sur les monts sous-marins de la ride de Lau. La partie supérieure des pentes présente des fonds rocheux jusqu'à 600 m de profondeur. Plus profondément, on retrouve les fonds envasés couverts de pierres ponces. Dans certaines îles particulièrement isolées (Vanua Balavu, Yacata, Aiwa et Yagasa), un échantillonnage de la malacofaune terrestre a été réalisé.

ABSTRACT

The BORDAU Cruise on the Lau Ridge (Fijian Archipelago). Report and list of stations.

The BORDAU 1 cruise was carried out in the Fijian Archipelago from 22 February to 14 March 1999 on board of R.V. *"Alis"*. A total of 118 samples were made by dredging and trawling in the upper bathyal zone and in the circalittoral depths of the islands and on the seamounts in the Lau Ridge. The upper part of the slope to 600 m consists of hard bottoms and deeper muddy bottoms with pumice. In some islands particularly isolated (Vanua Balavu, Yacata, Aiwa and Yagasa), the landsnails were sampled.

RICHER DE FORGES, B., BOUCHET, P., DAYRAT, B., WARÉN, A. & PHILIPPE, J.-S., 2000. — La campagne BORDAU 1 sur la ride de Lau (îles Fidji). Compte rendu et liste des stations. *In* : A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 21. *Mémoires du Muséum national d'Histoire naturelle*, **184** : 25-38. Paris ISBN-2-85653-526-7.

Source : MNHN, Paris

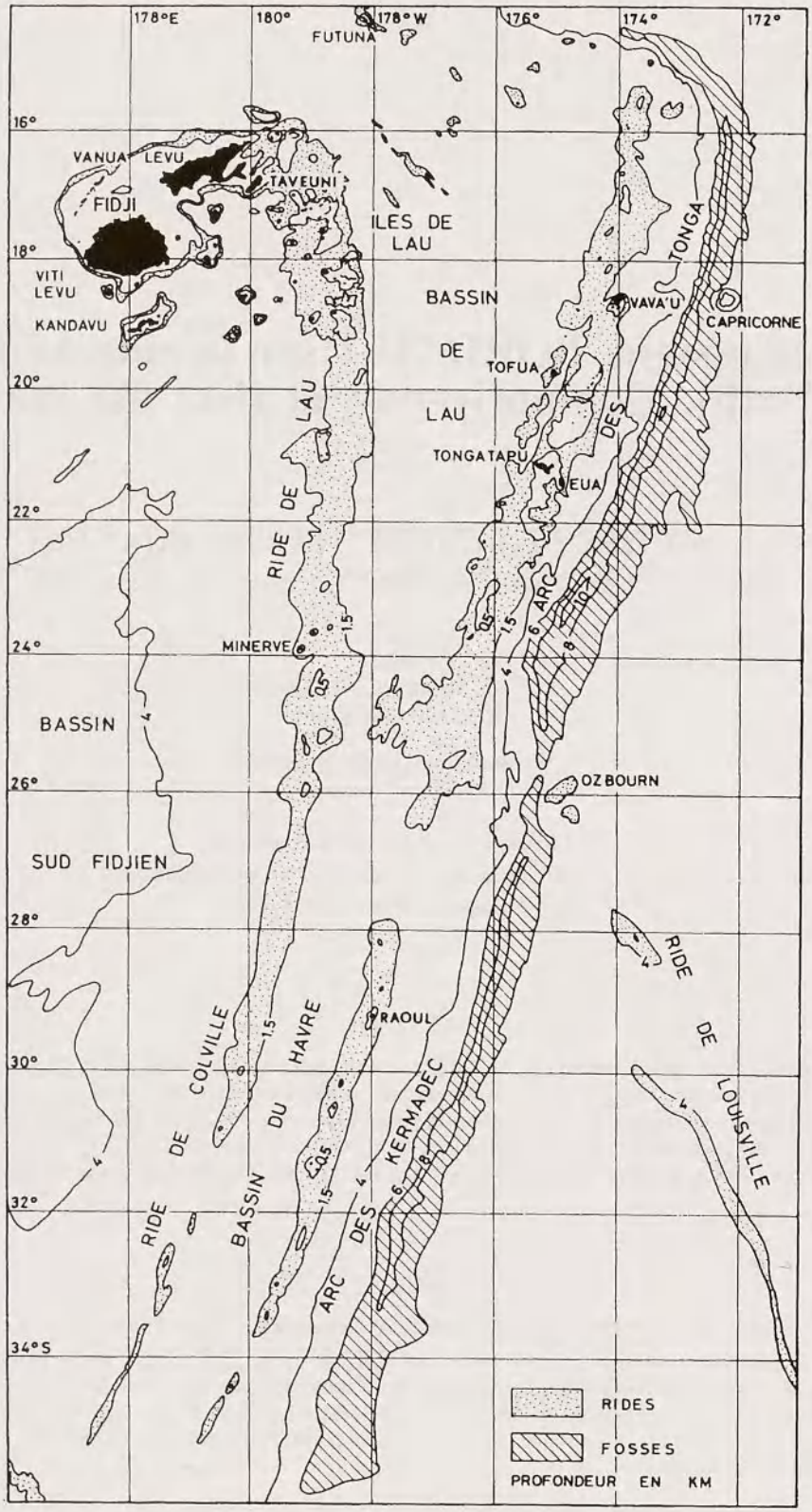

FIG. 1. — Géomorphologie de la partie orientale de la plaque Australo-Indienne montrant la ride de Lau-Colville et les bassins environnants (d'après ANONYME, 1982).

Source : MNHN, Paris

INTRODUCTION

La campagne BORDAU 1 est la première de deux campagnes destinées à échantillonner la faune bathyale de la bordure orientale de la plaque Australo-Indienne. Après une série de 10 campagnes d'exploration sous le nom de MUSORSTOM, auxquelles se sont ajoutées d'autres campagnes en Nouvelle-Calédonie et en Indonésie, les collections accumulées permettent, une fois les espèces décrites, de comprendre la répartition géographique et bathymétrique de ces espèces. Alors que l'objectif des campagnes MUSORSTOM et assimilées était de faire l'inventaire des faunes bathyales et de démontrer l'existence, en zone bathyale, d'un gradient décroissant de richesse spécifique d'Ouest en Est, les campagnes BORDAU 1 et BORDAU 2 ont d'autres objectifs. Elles doivent permettre d'observer la faune bathyale située en bordure des plaques.

Profitant de la disposition géographique et géomorphologique particulière des rides de Lau-Colville et de Tonga-Kermadec, l'échantillonnage permettra, de plus, de décrire la variation latitudinale de la faune benthique entre les îles franchement tropicales par 16° S et les monts sous-marins situés hors de la zone inter-tropicale, à la limite des eaux tempérées.

La campagne MUSORSTOM 10 a permis d'obtenir les premières données sur la faune de profondeur des îles Fidji avec 82 stations réalisées autour de l'île de Vitu Levu et, en grande partie, dans la zone de Bligh Water (RICHER DE FORGES *et al.*, 1999). La campagne BORDAU 1 a été consacrée à la partie est de l'archipel en échantillonnant les abords des îles de Lau (Fig. 1).

GÉNÉRALITÉS SUR LES ÎLES DE LAU

La ride de Lau correspond à l'arc d'îles formé par la subduction ancienne de la plaque Pacifique sous la plaque Australo-Indienne. Cette ride, appelée aussi Lau-Colville Ridge, s'étend sur près de 2400 km du nord-est des Fidji jusqu'à l'île nord de la Nouvelle-Zélande (Fig. 1). Elle s'est formée au Miocène, de 22 à 5 M.A., lorsque ce volcanisme d'arc concernait l'alignement Nouvelles-Hébrides, Fiji, Tonga (WOODHALL, 1985).

Actuellement, la subduction est active plus à l'est, au niveau de la ride Tonga-Kermadec. La ride de Lau sépare des bassins de plus de 3000 m de profondeur, le Bassin sud fidjien, à l'ouest et le Bassin de Lau, à l'est. Elle porte de nombreuses îles hautes d'origine volcanique (fin Oligocène), mais également des atolls coralliens et des récifs soulevés. Le groupe des îles de Lau, parfois nommé "Eastern group" des Fidji, s'étend, du nord au sud, des formations récifales situées par 16°S jusqu'au Minerva Reef par 24°S. Les îles émergées les plus au sud de cet alignement sont Ono-i-Lau et Tuvana-i-Colo par 21°S (Fig. 3).

Cette région, d'une grande complexité tectonique, a fait l'objet de nombreuses études de géologie et géophysique (PELLETIER *et al.*, 1998; PELLETIER, 1999). Le bassin de Lau est en cours d'ouverture très active et présente des sources hydrothermales (TIFFIN, 1991). Les vitesses d'ouverture du bassin de Lau sont de l'ordre de 6,5 à 13 cm/an (PELLETIER *et al.*, 1998).

La faune des sources hydrothermales du bassin de Lau, récoltée au cours des campagnes en submersibles, BIOLAU 1989 et NAUTILAU 1990 (DESBRUYÈRES *et al.*, 1994), a donné lieu à plusieurs travaux de zoologie (GUINOT, 1990; GEISTDOERFER, 1991). DESBRUYÈRES et SEGONZAC (1997), dans leur ouvrage présentant un inventaire illustré des faunes des sources hydrothermales, recensent 22 espèces du Bassin de Lau.

DÉROULEMENT DE LA CAMPAGNE BORDAU 1

Les participants (Fig. 2) : Pour la réalisation de cette première campagne BORDAU, l'équipe scientifique se composait, de trois anciens des campagnes MUSORSTOM, P. BOUCHET, B. RICHER DE FORGES et B. DAYRAT, de J.S. PHILIPPE, un étudiant travaillant actuellement sur les bases de données de profondeur au Centre IRD de Nouméa et du Professeur A. WARÉN (l'inventeur de la drague DW). Le Professeur P. NEWELL, de l'University of the South Pacific, qui devait embarquer comme représentant des Fidji, en fut empêché par sa charge d'enseignement.

Source : MNHN, Paris

FIG. 2. — Les participants de la campagne BORDAU 1 sur la plage arrière du N.O. *"Alis"*, dans le port de Suva. De gauche à droite : Jean-Sébastien PHILIPPE; Benoît DAYRAT; Bertrand RICHER DE FORGES; Philippe BOUCHET; Anders WARÉN.

L'itinéraire : Après un départ du N.O. *"Alis"* de Suva en fin de journée du 22 février, les premières opérations débutèrent dans Somo-somo Strait, chenal situé entre les deux grandes îles hautes de Taveuni et Vanua Levu (NUNN, 1994, 1998). Ce passage profond de 600 à 800 m, correspondrait, comme Natewa Bay, à une faille. Il présente un étranglement étroit avec des fonds de 300 m dans lequel on observe, en période de vives eaux, de très forts courants de marées (> 3 noeuds). Les débris végétaux flottants y sont abondants en surface et, une fois coulés, s'accumulent sur les fonds, de part et d'autre du seuil (Fig. 3-4a). La première station réalisée le 23 février, faisant suite aux opérations des campagnes MUSORSTOM, porte le numéro DW 1391. Deux journées furent consacrées à l'exploration de ce chenal, le 23 février (DW 1391-DW 1399) et le 4 mars (CP 1447-DW 1455). La première journée rencontra principalement des fonds vaseux à débris végétaux, mais aussi un fond de sable grossier coquillier vers 400 m. Pour la deuxième journée, les tentatives de dragages sur le seuil, de 300 à 400 m, s'avérèrent très difficiles et peu fructueuses.

Vanua Levu. — Une journée fut consacrée à l'échantillonnage de la vaste baie Natewa qui entaille sur plus de 35 milles, au nord-est, l'île de Vanua Levu (CP 1400-CP 1407). Dans l'axe de la baie Natewa on trouve des profondeurs de plus de 1000 m et des fonds vaseux. Les stations de l'extrémité de la baie sont par petits fonds, de moins de 150 m.

Il faut rappeler que le méridien 180° coupe l'île de Vanua Levu et passe exactement par Somo-somo Strait. En conséquence, certaines stations de Somo-somo Strait ont des coordonnées avec une longitude est (DW 1391-CP 1395; CP 1447-DW 1455), ainsi que celles du fond de la baie Natewa (CP 1402-CP 1407), alors que toutes les autres stations de la campagne ont des coordonnées en longitude ouest.

En quittant Vanua Levu, le cap fut mis sur un groupe de récifs situé par 16°S où se déroulèrent les prélèvements de la journée du 26 février (DW 1408-CP1413). Les prélèvements sur les pentes, vers 500-600 m, ramenèrent des pierres ponces et leur faune associée : cirripèdes, pagures Pylochelidae, crevettes Glyphocrangonidae, crabes Cyclodorripidae et Ethusinae, mollusques *Propeamussium*, Xenophoridae; vers 400 m de profondeur, des éponges Hexactinellides, des crabes *Pleistacantha*, *Macropodia*, *Psopheticus*, *Mursia* et des Brachiopodes. Signalons la

Source : MNHN, Paris

découverte à la station CP 1412, par 400 m de profondeur, de l'espèce *Lyria planicostata*, qui devient ainsi la volute la plus à l'est du Pacifique (BOUCHET & POPPE, 1995).

La journée du 27 février se déroula en opérations (DW 1414-DW 1418) sur un mont sous-marin qui culmine vers 220 m de profondeur (16°31'S - 178°59'W). La partie sommitale, couverte d'une épaisse couche de manganèse (> 15 cm), se révéla très difficile à draguer. Parmi la petite quantité d'organismes récoltés, furent trouvés deux spécimens du crinoïde pédonculé *Gymnocrinus richeri*. Ce "fossile vivant", appartenant à une famille supposée éteinte au Jurassique (Hemicrinidae), décrit d'un mont sous-marin de la ride de Norfolk en 1985, avait jusqu'alors été retrouvé seulement aux îles Loyauté et sur la pente externe de l'île Wallis (RICHER DE FORGES, 1990; RICHER DE FORGES & MENOU, 1993).

Les quatre jours suivant furent consacrés à l'exploration des pentes de l'île de Vanua Balavu (CP 1419-CP 1446).

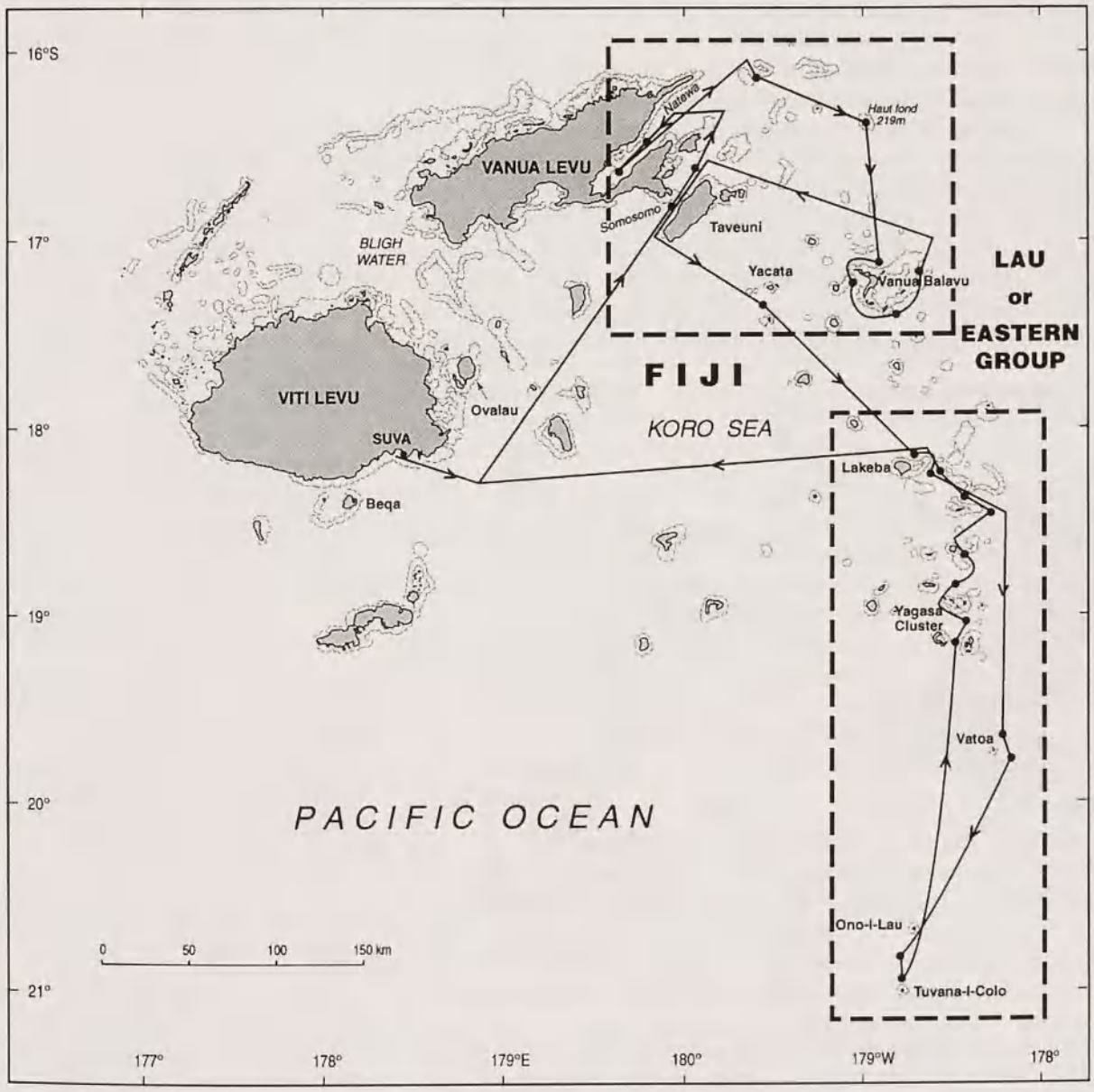

FIG. 3. — Itinéraire de la campagne BORDAU 1 dans les îles de Lau. Chaque point représente une zone où plusieurs opérations de dragages et de chalutages ont eu lieu (cf. liste des stations en Annexe).

Source : MNHN, Paris

Vanua Balavu. — L'île de Vanua Balavu, d'une superficie de 54,6 km^2, culmine à 283 m. Elle est constituée de plusieurs îlots entourés d'une longue barrière corallienne délimitant un vaste lagon (Fig. 4 a). La partie nord de cet ensemble d'îles semblait propice au chalutage d'après les cartes bathymétriques établies par le CCOP/SOPAC (Mineral Resources Dept. Fiji; 1/250 000 bathymetric map series). En fait les pentes, relativement douces entre 500 et 700 m de profondeur, sont hérissées de nombreux pinacles volcaniques rendant toute opération avec des engins trainants hasardeuse. Les quelques prélèvements réussis montrent des fonds envasés et recouverts de pierres ponces avec des mollusques *Xenophora* et *Propeamussium*.

Sur le versant ouest, dans le chenal séparant l'île Kanacea de Vanua Balavu, les fonds de 350 à 420 m sont graveleux, avec des débris coquilliers. Les espèces remarquables sont des crustacés : la langouste fouet (*Puerulus angulatus*), des crabes Raninidae (*Lyreidius, Cosmonotus*), Goneplacidae (*Hexaplax*), Cyclodorripidae, Palicidae, Majidae et des Galatheidae (*Munida*); des poissons, Soleidae, Callionymidae, Scorpenidae.

Au sud-est de l'île, se trouvent des fonds à débris coquilliers et coquilles de ptéropodes, assez riches en micromollusques et, par endroit, des pierres ponces avec de très nombreux pagures Pylochelidae foreurs. Le trait CP 1433 rapporta une grande quantité de pierres ponces et un gros morceau de dalle de grès avec une faune riche en crustacés : *Paromola crosnieri* (trouvée pour la première fois hors de Nouvelle-Calédonie), *Platymaia, Randallia granulosa, Munida* spp., cirripèdes pédonculés.

Le versant est de l'île présente une pente relativement douce où plusieurs chalutages fructueux furent réalisés entre 300 et 400 m : crevettes Peneidae (*Metapenaeopsis*), Crangonidae, Pandalidae; crabes Leucosidae (*Randallia*), Majidae (*Pleistacantha, Achaeus*); nombreux échinodermes ophiurides. Par ailleurs, il existe une passe étroite et profonde (American Passage), d'une morphologie tout à fait exceptionnelle. En effet, une entaille pénètre sur plus de 4 milles nautiques à l'intérieur du lagon, formant une sorte de canyon de près de 200 m de profondeur dans un lagon où les profondeurs environnantes sont de 50 à 60 m. Les stations DW 1435 à DW 1439 furent consacrées à l'échantillonnage de ce canyon : les fonds y sont composés d'un sable vaseux fin et blanc, de débris d'*Halimeda* et de foraminifères; la faune y est largement dominée par une espèce d'échinide (du genre ? *Maretia*), si abondant que les chaluts à perche (CP 1437-1438) en furent entièrement colmatés.

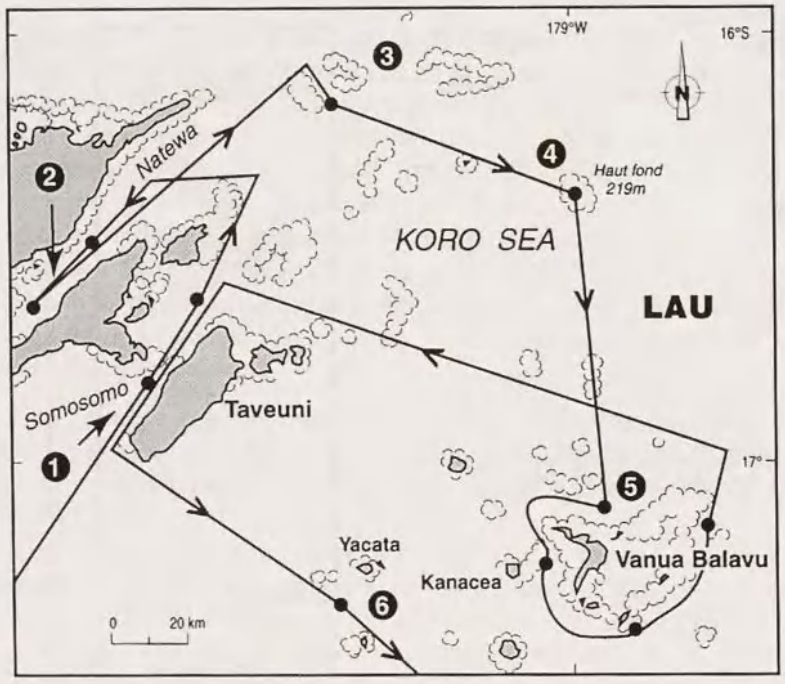

FIG. 4 a. — Carte des îles de Lau. **1** : Somo-somo Strait (DW 1391-1399; CP 1447-DW 1455); **2** : Natewa Bay (CP 1400-1407); **3** : Récifs par 16°S-179°29'W (DW 1408-CP 1413); **4** : Haut fond par 16°27'S-178°55'W (DW 1414-1418); **5** : Vanua Balavu (CP 1419-1446); **6** : Yacata (DW 1456-1459).

Après être retourné le 4 mars dans Somo-somo Strait pour tenter d'y retrouver la faune des fonds sableux, l'échantillonnage des îles de Lau reprit le 5 mars, au niveau de l'île Yacata (Fig. 3, 4a). Cette île, calcaire, isolée, culmine à 248 m, entre Taveuni et Vanua Balavu; ses pentes sont très raides et les prélèvements ont eu lieu entre 600 et 1300 m sur des fonds envasés à pierres ponces (la sonde XBT indiquait 5°C à 850 m). Les organismes récoltés furent essentiellement des crustacés : crabes Cyclodorripidae, Ethusinae; crevettes (*Glyphocrangon, Heterocarpus longirostris*); anomoures (*Lithodes, Bathymunida, Munida*); isopodes Serolidae et Antarcturidae.

Lakeba. — Le groupe de Lakeba (ou Lakemba) comporte plusieurs îles dont la plus grande a une superficie de 56 km^2 et culmine à 220 m (Fig. 4b). Deux journées furent consacrées à la faune bathyale, la journée du 6 mars

Source : MNHN, Paris

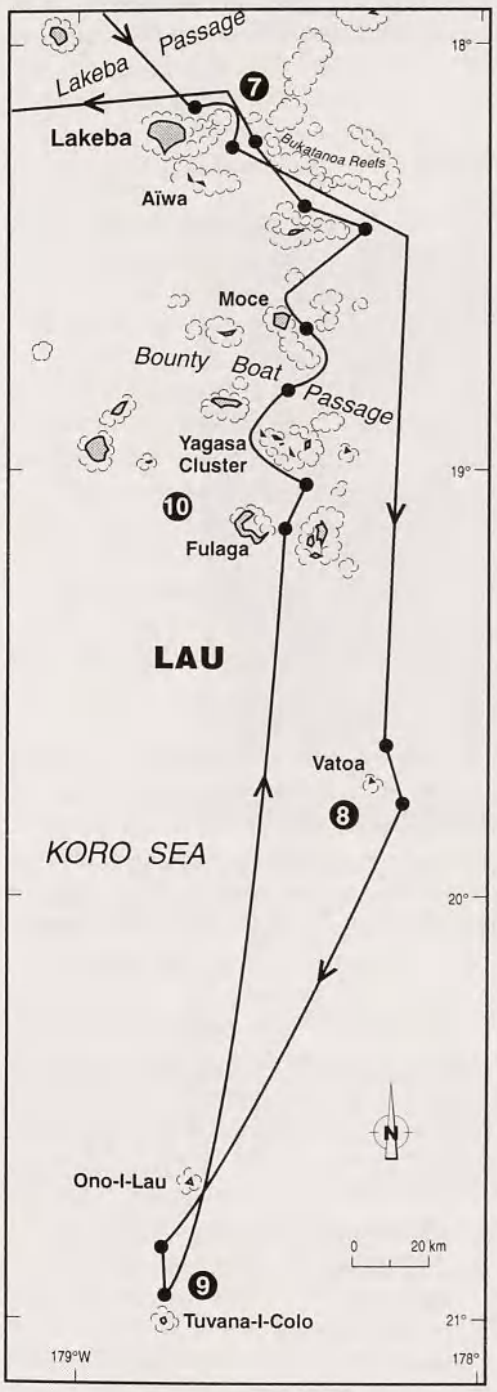

FIG. 4 b. — Carte des îles de Lau. **7** : Lakeba (CP 1460-1468; CP 1502-1507); **8** : Vatoa (DW 1469-CP 1476); **9** : Tuvana-i-Colo (DW 1477-1483); **10** : Yagasa cluster (CP 1484-1501).

Figures 4 a et 4b d'après la carte du "Hydrographic Service of the Navy, England", n°4632 .

(CP 1460-1468) puis celle du 13 mars (CP 1502-1507). La journée du 7 mars, jour de repos, fut utilisée pour des récoltes de mollusques terrestres sur l'île corallienne surélevée d'Aiwa (60 m d'altitude), au sud-est de Lakeba. Les stations réalisées dans le chenal compris entre l'île Lakeba et le grand atoll de Bukatanoa, de 250 à 450 m, ramenèrent du sable grossier et des blocs calcaires. Sur ces fonds fut trouvée une faune riche en crustacés avec des crabes Majidae (*Oxypleurodon, Pugetia, Platymaia, Pleistacantha*), des Calappidae (*Mursia*), des crevettes Stylodactylidae et des anomoures Pylochelidae et Galatheidae (*Munida, Munidopsis*). Signalons, à la station CP 1504, vers 430 m de profondeur, la présence de crabes de la famille rare des Retroplumidae.

Plus profondément, vers 650 à 800 m, on retrouve, sur les fonds à pierres ponces, des crevettes (*Glyphocrangon*, *Heterocarpus* spp.) et des crabes (*Randallia, Platymaia*).

Vatoa. — Après une nuit de navigation, directement en quittant l'île d'Aiwa, la petite île de Vatoa (19°49,7'S - 178°13,4'W) fut atteinte le 8 mars. Plusieurs épaves sur les côtes de cette île rappellent les réels dangers de cette région mal cartographiée. Les pentes furent échantillonnées entre 250 et 400 m (DW 1469-CP 1476). Les stations les moins profondes ramenèrent des blocs de calcaires et des sédiments grossiers détritiques (DW 1472). Parmi ces sédiments figuraient des débris d'éponges calcifiées du groupe des Sphinctozoaires ainsi que des crabes Raninidae et Palicidae.

Ono-i-Lau et Tuvana-i-Colo. — Profitant toujours d'une navigation de nuit pour descendre en latitude, le groupe d'îlots de Ono-i-Lau et Tuvana-i-Colo fut atteint le 9 mars (DW 1477-1483). Il s'agit des reliefs émergés les plus au Sud et les plus isolés de l'archipel des Fidji. Ono-i-Lau (20°38'S-178°41'W) est formé d'un groupe de 6 îlots entourés de récifs alors que Tuvana-i-Colo (21°00'S-178°43'W) est une île solitaire, également entourée de récifs. Les fonds explorés, de 350 à 500 m, permirent la récolte de crustacés Leucosidae, Majidae, Parthenopidae, Dromiidae, Raninidae, de mollusques Turridae, Pectinidae et scaphopodes.

Yagasa cluster. — Le groupe d'îles du sud de la ride de Lau, centré autour de Yagasa Cluster, fut étudié au retour de Tuvana-i-Colo, du 10 au 12 mars (CP 1484-1501). Par lui-même, l'atoll de Yagasa Cluster est formé d'un récif barrière d'environ 7 milles de diamètre, ouvert au Nord, qui enserre 4 îles dont Yagasa Levu qui culmine à 119 m (ANONYME, 1996). Comme dans le reste de l'archipel, on observe des fonds envasés à pierres ponces en dessous de 500 m et dans les petites profondeurs (400-200 m) des blocs calcaires et des sables grossiers. La station DW 1488 fut particulièrement riche en microgastéropodes et en Pylochelidae. Signalons à la station CP 1490 la récolte du crabe Majidae

Source : MNHN, Paris

Cyrtomaia furici, décrit des îles Chesterfield (GUINOT & RICHER DE FORGES, 1988). Un dragage réalisé dans la passe de Yagasa, par 240 à 319 m de profondeur, sur un fond de sable fin vaseux, rapporta des crabes Raninidae (*Lyreidius, Raninoides*), Leucosidae et des crevettes Penéides (*Metapenaeopsis, Solenocera*), Crangonidae.

REMARQUES SUR LES RÉCOLTES

La faune marine. — Les peuplements des fonds vaseux vers 500 à 700 m sont fréquemment dominés par de gros oursins irréguliers, rouge-violet, portant de petites ophiures commensales et des cirripèdes pédonculés. Sur ce type de fond à pierre ponces, les Paguridae du genre *Parapagurus*, associés à une Actinie, sont fréquents.

Une fois encore, la faune associée aux végétaux coulés est très intéressante : mollusques cocculiniformes dans les noix de coco, *Leptochiton*, crustacés Galatheides et Amphipodes.

Parmi les crustacés récoltés, certaines espèces, décrites de Nouvelle-Calédonie, ont été retrouvées pour la première fois. C'est le cas d'*Oxypleurodon orbiculatus*, décrite du sud de la Grande Terre (GUINOT & RICHER DE FORGES, 1985) et de *Paromola crosnieri*. Par contre, dans le genre *Pleistacantha*, c'est l'espèce indonésienne, *P. terribilis*, qui est présente sur la ride de Lau et non celle décrite de Nouvelle-Calédonie, *P. exophthalmus*.

Le crinoïde pédonculé *Gymnocrinus richeri* est retrouvé de nouveau et son aire de répartition connue devient maintenant : ride de Norfolk, îles Loyauté, île Wallis et ride de Lau. Ces localités sont situées sur la plaque Australo-Indienne, à l'exception de Wallis. Cependant, si l'on prend en compte l'évolution tectonique récente du sud-ouest Pacifique (AUZENDE *et al.*, 1995), la zone située au sud de la fosse de Vitiaz, entre celle-ci et la fosse des Nouvelles-Hébrides est de formation récente. La présence de cette espèce archaïque semble donc bien liée à la plaque Australo-Indienne.

La malacofaune terrestre. — Les îles du Pacifique sont célèbres pour leurs faunes de mollusques terrestres, très diversifiées et présentant de hauts niveaux d'endémisme. Au sein de l'archipel fidjien, le groupe de Lau est original, tant par la composition générale des peuplements, que par l'endémisme local. Par rapport aux grandes îles, les *Placostylus* manquent, les grandes *Orpiella* (Helicarionidae) et les Diplommatinidae sont pratiquement absents; par contre, les *Partula* n'existent à Fidji qu'aux îles de Lau, et c'est dans cet archipel que les Assimineidae atteignent leur plus grande diversification, avec en particulier le genre endémique *Fijianella*. Les Endodontidae, famille polynésienne par excellence, n'existent à Fidji qu'aux îles de Lau, avec notamment les genres endémiques *Priceconcha* et *Zyzzyxdonta*. Les sous-genres d'Helicarionidae *Diastole (Laua)* et *Lamprocystis (Naiaua)* et les genres de Charopidae *Maafu* et *Lauopa* sont également endémiques de Lau. Par suite de la disparition des forêts naturelles et de l'introduction d'espèces envahissantes, les malacofaunes terrestres des îles du Pacifique connaissent des taux d'extinction parmi les plus élevés de la planète. Or nos connaissances sur les mollusques terrestres des îles de Lau sont fragmentaires et anciennes : elles sont fondées sur les collectes d'E. GRAEFFE (1870), E.H. BRYAN (août-septembre 1924), H. LADD (juillet-août 1934), Y. KONDO (août 1938) et enfin L. PRICE (1970). Les difficultés de déplacement à l'intérieur de l'archipel et les conditions météorologiques au moment de leur visite font que toutes les îles sont loin d'avoir été convenablement échantillonnées. C'est pourquoi la campagne BORDAU 1 a été mise à profit pour débarquer sur six îles calcaires : Evuevu et Cikobia-i-Lau (groupe de Vanua Balavu), Yacata, Aiwa, et enfin Yagasa Levu et Navutu-i-Loma (groupe de Yagasa). Sur chacune des îles, les récoltes comprennent des ramassages à vue et des prélèvements de litière, et représentent un échantillonnage adéquat de la malacofaune. De plus, des *Partula lirata* de Cikobia-i-Lau ont été conservées vivantes jusqu'au retour à Suva et expédiées au Zoo de Londres (Dr P. PEARCE-KELLY) qui maintient en élevage *ex situ* plus de 30 espèces de *Partula* des îles du Pacifique.

La pollution. — On pourrait croire que ces îles, isolées au milieu du Pacifique et relativement peu peuplées, échappent à l'un des fléaux de notre temps, la pollution (BENTON, 1991, 1995). Il n'en est rien ! Une coutume ancestrale océanienne semble considérer l'océan comme une vaste poubelle où tout disparaît. À plusieurs reprises pendant les deux campagnes réalisées aux Fidji, les chaluts, dans la zone bathyale, ont rapporté de nombreux détritus, sacs en plastiques, vieux pneus... Devant la passe de Suva, par 400 m de profondeur, cela pouvait passer

Source : MNHN, Paris

pour une conséquence logique de l'activité portuaire et de la proximité de la grosse décharge urbaine de la ville de Suva. Dans la zone de Bligh Water, la présence de détritus en plastique était déjà plus surprenante. Mais le summum de la surprise fût atteint entre Taveuni et Vanua Levu, dans la zone de Somo-somo Strait. En 30 minutes de chalutage par 600 m de profondeur (CP 1392) fut remontée une impressionnante quantité de boîtes de conserves, de torches électriques et de bouteilles en matières plastiques (Fig. 5).

Bien sûr, cette pollution n'atteint pas encore le niveau catastrophique des mers d'Europe mais compte tenu des petites populations responsables, il y a de quoi être inquiet pour l'avenir.

FIG. 5. — Détritus trouvés dans un trait de chalut à perche d'une demi-heure dans Somo-somo Strait, par 600 m de profondeur (CP 1392).

CONCLUSIONS

Au terme des deux campagnes MUSORSTOM 10 et BORDAU 1, c'est 200 opérations de dragages et de chalutages qui ont été réalisées, pour la plupart, dans la zone bathyale de l'archipel des îles Fidji. Les collections zoologiques ainsi faites améliorent considérablement nos connaissances sur cette région du Pacifique sud-ouest, précisant la répartition d'espèces décrites de Nouvelle-Calédonie ou enrichissant d'espèces nouvelles certains genres connus plus à l'ouest.

Les observations préliminaires, faites pendant la campagne, semblent confirmer l'existence, en zone bathyale, d'un fond faunistique du sud-ouest Pacifique s'appauvrissant d'ouest en est.

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Source : MNHN, Paris

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ANNEXES

LISTE DES PARTICIPANTS À LA CAMPAGNE BORDAU 1

Chef de mission : B. RICHER DE FORGES.

Autres participants : P. BOUCHET, A. WARÉN, B. DAYRAT, J.- S. PHILIPPE.

LISTE DES STATIONS DE LA CAMPAGNE BORDAU 1

(DW : drague Waren; CP : chalut à perche)

Stations	Date (1999)	Profondeur (m)	Latitude Sud	Longitude
Somo-somo Strait				
DW 1391	23.02	600-660	16°49,33'	179°54,45'E
CP 1392	" "	545-651	16°49,30'	179°54,70'E
DW 1393	" "	426-487	16°45,17'	179°59,17'E
CP 1394	" "	416	16°45,19'	179°59,19'E
CP 1395	" "	423-500	16°45,13'	179°59,20'E
CP 1396	24.02	591-596	16°38,98'	179°57,16'W
CP 1397	" "	674-688	16°32,60'	179°51,90'W
CP 1398	" "	907-912	16°21,80'	179°55,70'W
DW 1399	" "	400-400	16°23,67'	179°55,49'W
Natewa Bay				
CP 1400	25.02	1004-1012	16°28,22'	179°50,66'W
CP 1401	" "	600-648	16°34,92'	179°40,66'W

Source : MNHN, Paris

CP 1402	" "	260-279	16°38,33'	179°36,40'E
CP 1403	" "	220-224	16°39,60'	179°35,96'E
CP 1404	" "	180	16°39,87'	179°35,70'E
CP 1405	" "	180	16°39,30'	179°35,61'E
CP 1406	" "	360-380	16°39,47'	179°36,93'E
CP 1407	" "	499-527	16°39,67'	179°38,69'E
Récifs (16°S-179°29'W)				
DW 1408	26.02	550-561	16°01,91'	179°29,75'W
CP 1409	" "	557-558	16°01,88'	179°29,83'W
DW 1410	" "	400-410	16°05,51'	179°27,76'W
CP 1411	" "	390-403	16°05'47'	179°27,83'W
CP 1412	" "	400-407	16°05,52'	179°28,05'W
CP 1413	" "	669-676	16°10,24'	179°24,25'W
Mont sous-marin (16°27'S-178°55'W)				
DW 1414	27.02	630-689	16°31,12'	178°59,27'W
CP 1415	" "	670-682	16°31,05'	179°00,29'W
CP 1416	" "	441-450	16°29,90'	178°58,61'W
DW 1417	" "	353	16°27,07'	178°55,19'W
DW 1418	" "	367	16°27,63'	178°55,73'W
Vanua Balavu				
CP 1419	28.02	654-656	17°04,94'	178°54,85'W
CP 1420	" "	550-687	17°05,33'	178°57,04'W
DW 1421	" "	403-406	17°07,95'	178°59,25'W
DW 1422	" "	360-371	17°08,34'	178°59,29'W
DW 1423	" "	402-410	17°08,01'	178°59,10'W
DW 1424	01.03	385-416	17°16,61'	179°01,25'W
DW 1425	" "	400-416	17°16,70'	179°01,34'W
DW 1426	" "	330-367	17°15,13'	179°01,55'W
CP 1427	" "	364-369	17°16,26'	179°01,06'W
CP 1428	" "	400-405	17°15,13'	179°01,30'W
CP 1429	" "	400-410	17°16,75'	179°01,38'W
DW 1430	02.03	458-500	17°20,94'	179°01,38'W
CP 1431	" "	495-500	17°19,61'	178°42,47'W
DW 1432	" "	477-493	17°19,90'	178°44,25'W
CP 1433	" "	488-500	17°19,93'	178°42,89'W
CP 1434	" "	400-401	17°11,48'	178°41,38'W
DW 1435	" "	170-183	17°10,69'	178°45,29'W
CP 1436	" "	164-180	17°10,63'	178°44,25'W
CP 1437	" "	160-177	17°11,17'	178°45,80'W
CP 1438	03.03	97-104	17°13,18'	178°48,03'W
DW 1439	" "	173-180	17°10,58'	178°44,11'W
DW 1440	" "	190-308	17°10,51'	178°42,93'W
DW 1441	" "	306-320	17°09,78'	178°42,07'W
CP 1442	" "	400-403	17°11,31'	178°41,36'W
CP 1443	" "	384-400	17°09,20'	178°41,43'W

Source : MNHN, Paris

CP 1444	" "	398-409	17°11,13'	178°41,41'W
CP 1445	" "	350-365	17°10,42'	178°41,78'W
CP 1446	" "	350-367	17°11,34'	178°42,03'W
Somo-somo Strait				
CP 1447	04.03	420-513	16°45,23'	179°59,13'E
CP 1448	" "	410-500	16°45,04'	179°58,97'E
CP 1449	" "	386-400	16°43,24'	179°57,65'E
DW 1450	" "	327-420	16°44,45'	179°58,50'E
DW 1451	" "	400-460	16°44,74'	179°59,53'E
CP 1452	" "	420-508	16°43,88'	179°59,70'E
DW 1453	" "	414-510	16°45,03'	179°59,30'E
DW 1454	" "	300-370	16°45,77'	179°58,74'E
DW 1455	" "	300-450	16°46,66'	179°58,21'E
Yacata				
DW 1456	05.03	650-696	17°15,95'	179°34,70'W
CP 1457	" "	942-976	17°19,39'	179°34,13'W
CP 1458	" "	1216-1226	17°21,52'	179°28,00'W
DW 1459	" "	820-863	17°18,33'	179°33,40'W
Lakeba				
CP 1460	06.03	750-767	18°47,06'	178°47,29'W
CP 1461	" "	560	18°08,83'	178°47,70'W
CP 1462	" "	556-560	18°09,31'	178°44,27'W
DW 1463	" "	300-400	18°10,10'	178°44,34'W
DW 1464	" "	285-300	18°08,67'	178°37,68'W
DW 1465	" "	290-300	18°08,74'	178°38,63'W
DW 1466	" "	416-440	18°11,92'	178°36,89'W
CP 1467	" "	417-427	18°11,80'	178°35,80'W
CP 1468	07.03	478-500	18°16,45'	178°41,30'W
Vatoa				
DW 1469	08.03	314-377	19°40,01'	178°10,24'W
CP 1470	" "	316-323	19°39,59'	178°10,27'W
DW 1471	" "	280-296	19°40,09'	178°10,25'W
DW 1472	" "	262-266	19°40,48'	178°10,24'W
DW 1473	" "	270-288	19°42,68'	178°10,27'W
CP 1474	" "	316-340	19°39,21'	178°10,23'W
CP 1475	" "	321-424	19°40,70'	178°11,15'W
CP 1476	" "	310-420	19°41,50'	178°11,30'W
Tuvana-i-Colo				
DW 1477	09.03	390-405	20°57,97'	178°44,51'W
CP 1478	" "	386-396	20°58,55'	178°44,80'W
DW 1479	" "	450-460	20°58,05'	178°44,94'W
CP 1480	" "	437-466	20°58,90'	178°45,60'W
CP 1481	" "	441-506	20°57,50'	178°44,90'W
CP 1482	" "	350	20°58,13'	178°44,41'W

Source : MNHN, Paris

DW 1483	" "	337-360	20°58,89'	178°44,79'W
Yangasa Cluster				
CP 1484	10.03	680-723	19°02,95'	178°28,75'W
DW 1485	" "	700-707	19°02,69'	178°29,80'W
DW 1486	" "	395-540	19°00,58'	178°25,99'W
DW 1487	" "	200-250	18°57,41'	178°22,96'W
DW 1488	" "	500-516	19°01,33'	178°25,16'W
DW 1489	11.03	440-450	18°53,30'	178°29,90'W
CP 1490	" "	785-820	18°50,60'	178°32,13'W
CP 1491	" "	777-787	18°50,02'	178°27,07'W
DW 1492	" "	430-450	18°43,12'	178°22,63'W
CP 1493	" "	429-440	18°43,02'	178°23,74'W
DW 1494	12.03	240-319	18°54,95'	178°29,23'W
DW 1495	" "	420-445	18°53,18'	178°29,78'W
DW 1496	" "	392-407	18°43,50'	178°23,30'W
DW 1497	" "	335-350	18°43,52'	178°24,54'W
DW 1498	" "	300-307	18°40,60'	178°28,47'W
DW 1499	" "	389-400	18°39,82'	178°26,78'W
CP 1500	" "	366-389	18°41,74'	178°26,20'W
CP 1501	" "	350-357	18°39,68'	178°29,90'W
Lakeba				
CP 1502	13.03	640-660	18°20,61'	178°26,98'W
DW 1503	" "	430	18°12,07'	178°34,74'W
CP 1504	" "	427-440	18°13,22'	178°34,45'W
CP 1505	" "	420-450	18°12,29'	178°37,34'W
DW 1506	" "	294-300	18°08,62'	178°37,41'W
DW 1507	" "	255-290	18°09,03'	178°37,90'W

Source : MNHN, Paris

3

Porifera Hexactinellida: On *Euryplegma auriculare* Schulze, 1886, and formation of a new order

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ABSTRACT

Euryplegma auriculare, previously known off the coast of New Zealand, has recently been collected from the vicinity of New Caledonia, Fiji, Wallis and Futuna Islands. The description of spicules, structure and speculation on the origin of this species as well as reinvestigation of the related genera, *Tretopleura* and *Fieldingia*, has led to revision of the family Aulocalycidae and modification of its diagnosis. The scope of the family has been restricted to five genera: *Euryplegma*, *Aulocalyx, Rhabdodictyon*, *Ijimadictyon*, and *Leioplegma*. A new taxon Aulocalycoida, with the same rank as the orders Hexactinosa, Lychniscosa, Lyssacinosa, has been proposed to receive the reorganized family. It is distinguished by an aulocalycoid framework. The order Hexactinosa is thus restricted to include all of its former families except for the family Aulocalycidae. Two genera previously included in the Aulocalycidae, *Tretopleura* and *Fieldingia*, are reassigned because of their lack of an aulocalycoid framework. *Tretopleura* is referred to the hexactinose family Euretidae without a clear closest relative. *Fieldingia* (sensu stricto), still poorly known, is provisionally referred to the order Reticulosa, as incertae sedis, and possibly represents the only extant member of that group. It has some similarity to the family Stromatidiidae, but cannot be included in that taxon with the limited information now available. The position of Reticulosa in relation to the more well-known recent Hexactinellida taxa remains unclear.

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Source : MNHN, Paris

RÉSUMÉ

Porifera Hexactinellida : Sur *Euryplegma auriculare* Schulze, 1886. Création d'un ordre nouveau.

Euryplegma auriculare, connu jusqu'à présent du large de la Nouvelle-Zélande, a récemment été récolté au voisinage de la Nouvelle-Calédonie et des îles Fidji, Wallis et Futuna. La description des spicules et de la structure de cette espèce, liée à des hypothèses sur son origine, ainsi que le réexamen des genres voisins *Tretopleura* et *Fieldingia*, ont conduit à une révision de la famille Aulocalycidae et à la modification de sa diagnose. Le champ de la famille a été réduit à cinq genres : *Euryplegma*, *Aulocalyx*, *Rhabdodictyon*, *Ijimadictyon* et *Leioplegma*. Un nouveau taxon Aulocalycoida, ayant le même rang que les ordres Hexactinosa, Lychniscosa, Lyssacinosa, est proposé pour recevoir la famille ainsi révisée. Il se distingue par une organisation du squelette aulocalycoide. L'ordre Hexactinosa se trouve ainsi réduit à ses anciennes familles à l'exception de celle des Aulocalycidae. Deux genres inclus précédemment dans les Aulocalycidae, *Tretopleura* et *Fieldingia*, sont reclassés à cause de leur manque de structure aulocalycoide. *Tretopleura* est placé, à titre provisoire, dans la famille Euretidae appartenant aux Hexactinosa, bien qu'aucune autre forme de cette famille ne lui soit clairement très proche. *Fieldingia* (sensu stricto), encore mal connu, est provisoirement rattaché à l'ordre Reticulosa, en tant qu'*incertae sedis* et représente peut-être le seul membre de ce groupe encore existant. Il possède quelques similitudes avec la famille Stromatidiidae, mais ne peut être inclus dans ce taxon avec le peu d'information dont nous disposons actuellement. La position des Reticulosa par rapport aux Hexactinellida récents, bien mieux connus, reste obscure.

A large number of interesting Hexactinellida have been collected in recent years by French expeditions in the southwestern part of the Pacific Ocean. Some of these species were previously known only by a few specimens from restricted locations. One of them — *Euryplegma auriculare* — turns out to be a common species in this area. The numerous specimens of *E. auriculare* made available by these expeditions provide opportunity to redescribe the species and to discuss the systematics of the Aulocalycidae.

Abbreviations: MNHN, Muséum national d'Histoire naturelle (Paris); NHM, The Natural History Museum (London); IORAS, Institute of Oceanology of Russian Academy of Sciences (Moscow).

1. — DESCRIPTION OF *EURYPLEGMA AURICULARE* Schulze

Genus ***EURYPLEGMA*** Schulze, 1886

Euryplegma Schulze, 1886: 80.

TYPE SPECIES. — *E. auriculare* Schulze, 1886.

DIAGNOSIS (from SCHULZE 1887, emended here). — Fan-like, thin-walled sponge with aulocalycoid framework of choanosomal skeleton. Dermalia and atrialia are pentactins. Loose microhexactins are rarely found in the choanosomal framework. Microscleres are discohexasters, hemidiscohexasters and sometimes discohexactins.

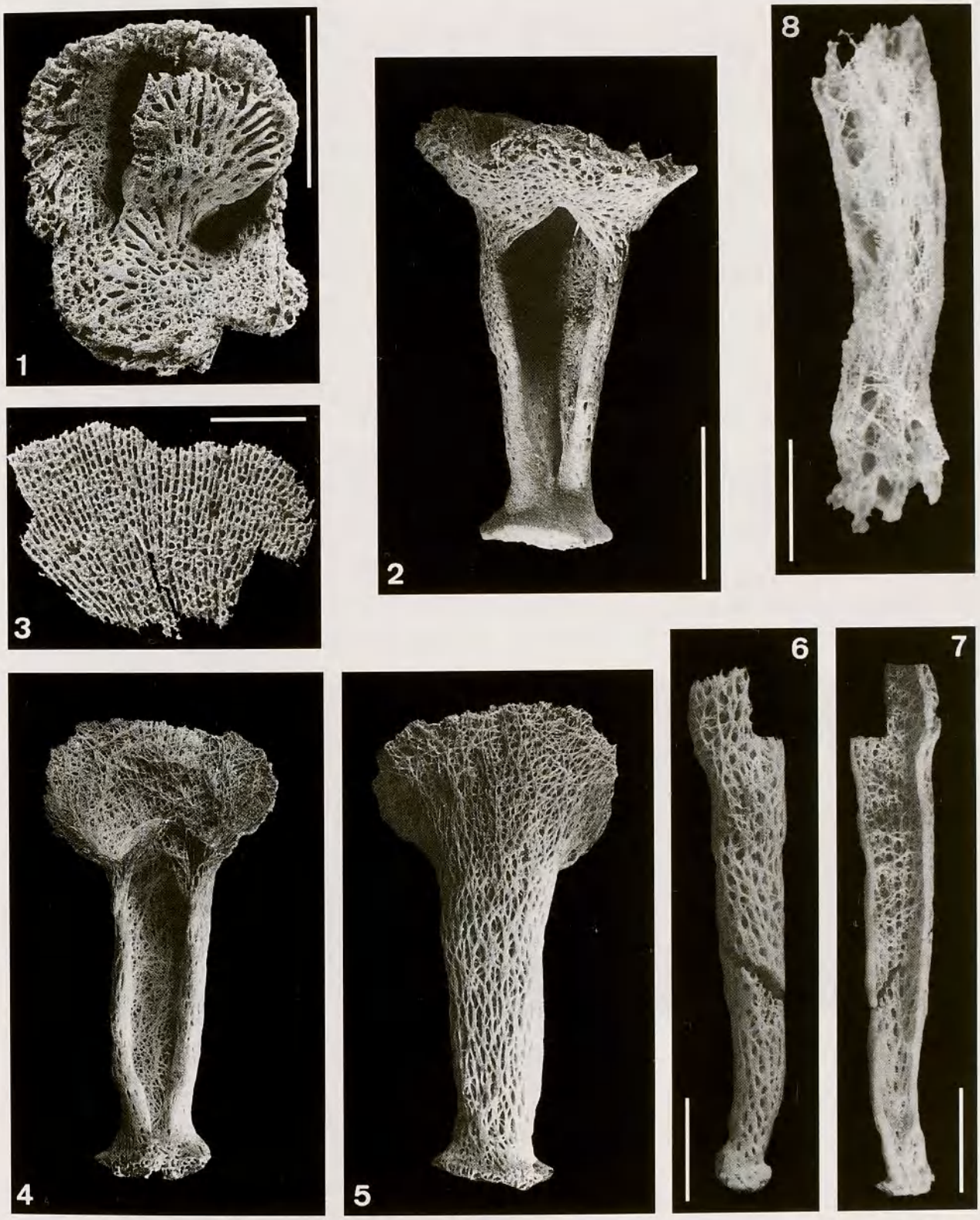
Euryplegma auriculare Schulze, 1886

Figs 1-13; Table 1

MATERIAL EXAMINED. — **New Zealand**. *"Challenger"*, stn 170 A, off Raoul or Sandy islands, 29°45'S, 178°11'W, 1120 m: *Lectotype* (BMNH 1887.10.20.075), *paralectotype* (BMHH 1887.10.20.075A).

New Caledonia. BIOCAL: stn CP 17, 20°34.54'S, 167°24.68'E, 3680 m, 14.08.1985: 2 specs (MNHN-HCL 366-368). — Stn CP 26, 22°39.66'S, 166°27.41'E, 1618-1740 m, 28.08.1985: 2 specs (MNHN-HCL 369-370). —

Source : MNHN, Paris



FIGS 1-8. — Fragments of *Euryplegma auriculare*: **1-2**, MNHN-HCL 369, upper and side view (scale 2 cm); **3-5**, MNHN-HCL 395, upper part side view and lower parts from two sides (scale 1 cm); **6-7**, MNHN-HCL 392, lower parts, views from 2 sides (scale 2 cm); **8**, MNHN-HCL 392, basal part (scale 1 cm).

Source : MNHN, Paris

Stn DW 33, 23°09.71'S, 167°10.27'E, 675-680 m, 29.08.1985: 2 specs (MNHN-HCL 372-373). — Stn DW 51, 23°05.27'S, 167°44.95'E, 700-680 m, 31.08.1985: 1 spec. (MNHN-HCL 374). — Stn CP 52, 23°05.79'S, 167°46.54'E, 600-540 m, 31.08.1985: 1 spec. (MNHN-HCL 371).

MUSORSTOM 4: stn CP 217, 22°3.60'S, 167°27'E, 850 m, 29.09.1985: 1 spec. (MNHN-HCL 396).

BIOGEOCAL: stn CP 238, 21°27.64'S, 166 23.41'E, 1300-1260 m, 13.04.1987: 10 specs (MNHN-HCL 375-382, 384-385). — Stn CP 265, 21°04.09'S, 167°00.40'E, 1760-1870 m, 18.04.1987: 6 specs (MNHN- HCL 386-391). — Stn CP 290, 20°36.91'S, 167°03.34'E, 920-760 m, 27.04.1987: 1 spec. (MNHN-HCL 392). — Stn CP 297, 20°38.64'S, 167°10.77'E, 1230-1240 m, 28.04.1987: 2 specs (MNHN-HCL 393-394)

CALSUB: Dive 12, 21°28'S, 166°21.50'E, 1265-700 m, 3.03.1989: 1 spec. (MNHN-HCL 395)

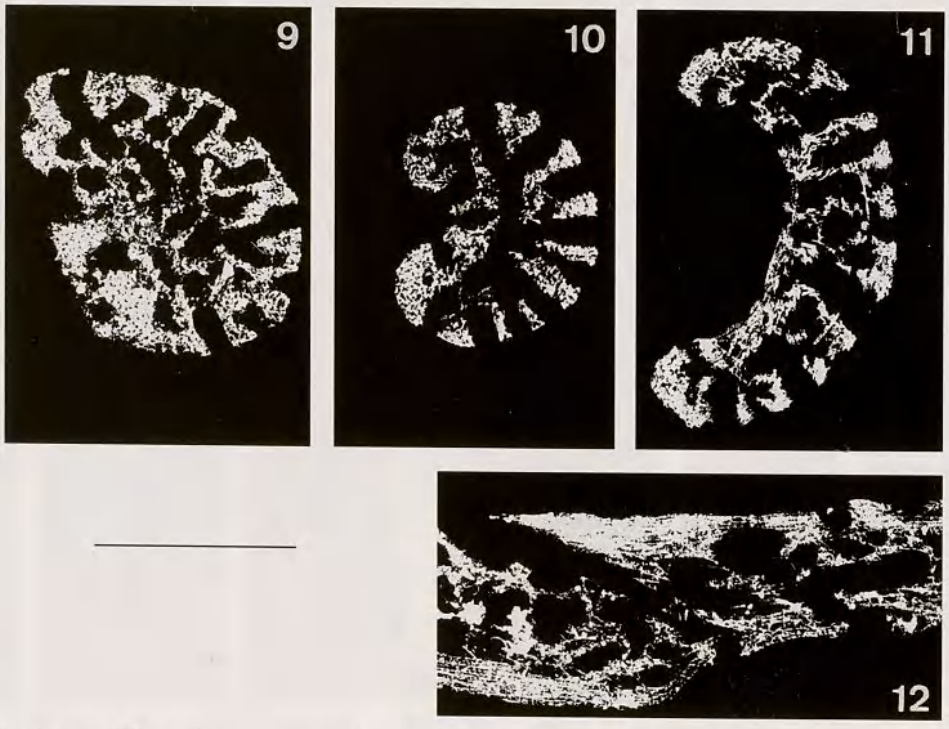
Loyalty Islands. MUSORSTOM 6: stn CP 427, 20°23.35'S, 166°20'E, 800 m, 17.02.1989: 1 spec. (MNHN-HCL398). — Stn CP 438, 20°23'S, 166°20.10'E, 780 m, 18.02.1989: 1 spec. (MNHN-HCL 397).

Fiji. DK-88-4-NBF, 1988, 12-13, stn 29, 16°39.89'S, 173°49.32'E, 2580 m (MNHN-HCL 383)

Wallis and Futuna Islands. MUSORSTOM 7: stn DW 539, 12°27.30'S, 177°27.30'W, 700 m, 17.05.1992: 1 spec. (ZMMU). — Stn CP 550, 12°14.80'S, 177 28'W, 800-810 m, 18.05.1992: 1 specs (MNHN-HCL 399). — Stn CP 564, 11°46.10'S, 178°27.40'W, 1015-1020 m, 20.05.1992: 2 spec. (MNHN-HCL 400-401). — Stn 636, 13°39.40'S, 179°55.50'W, 650-700 m, 30.05.1992: 1 spec. (MNHN-HCL 402).

TYPE MATERIAL. — *Lectotype* (BMNH 1887.10.20.075). *Paralectotype* (BMNH 1887.10.20.075A). Both collected by the HMS *"Challenger"*, stn 170 A, 29°45'S, 178°11'W, NE New Zealand, depth 1120 m.

DESCRIPTION. — *Body*: The sponge is tongue-like or similar to an ear-shaped plate; flabellate. Sections of most specimens, and especially the upper parts, are sickle-like with one surface convex and the other concave. Some fragments of the lower part of the body have a secondary funnel produced by ingrowth and union of the opposite edges (Fig. 1). Each of these fragments has a narrow, longitudinally directed slit enclosed by the union of the ingrown parts above. Oval and round orifices approximately 1-3 mm in diameter are located on both concave and convex surfaces. Investigation of transverse and longitudinal sections of specimen MNHN-HCL 395 showed that all internal interconnected canals (schizorhyses) are lined with pentactins identical with those of the dermal and atrial linings. Some orifices are covered by a mesh-layer containing the same pentactins.



FIGS 9-12. — Sections of *Euryplegma auriculare*: **9-11**, transverse sections through basal and upper parts; **12**, longitudinal section.

Source : MNHN, Paris

Status of existing type specimens has not been previously addressed. The specimen 1887.10.20.075A stored in The Natural History Museum (London) is marked with a type label. Since it is a fragment of macerated skeleton of the lower part of the body (SCHULZE, 1887, pl. 102, fig. 2) it is here designated as a paralectotype. The other specimen 1887.10.20.075 is 80 mm in length. It consists of the lower part of a sponge (SCHULZE, 1887, pl. 102, fig. 1) and contains the loose spicules. It is here designated as the lectotype.

The newly collected specimens are all fragments of the lower part of sponges. Some of them are represented by macerated skeletons, while others contain loose spicules which correspond in size to the type material. The largest complete fragment (MNHN-HCL 400) is over 140 mm in length. The thickness of the upper lamellar-like parts is 3-9 mm. The most complete specimen (MNHN-HCL 395) was broken during capture by the manipulator of the submersible. The lower part is 50 mm in length while the rest of the body part is represented by numerous flexible laminae 3-5 mm in thickness. The specimens contain none of the allochthonous loose spicules which have been reported from the type materials by REID (1957).

Spiculation: The choanosomal skeleton consists of a framework of aulocalycoid skeleton with numerous synapticular junctions. All central spicule nodes are hexaradiate. Since the walls between internal canals are thin (1-3 mm), most rays are bent to lie in a single plane, as occurs in framework dictyonalia of *Aphrocallistes*. The diameter of the aulocalycoid beams is 0.03-0.11 mm. They are smooth or covered with short spines. Free rays of these hexactins have rough tips or they are entirely rough.

The loose hexactins are numerous in the lectotype but are less abundant in all of the new specimens. These small hexactins are never fused to the framework as in most Farreidae and Euretidae. Choanosomal hexactins have rays 0.023-0.084 mm — probably up to 0.266/0.002-0.005 mm — covered with short spines. These choanosomal hexactins are numerous in the lectotype, common in the specimens HCL 387 and HCL 388, rare in HCL 395, HCL 389, HCL 392 and apparently absent in HCL 372, HCL 396. Only one large choanosomal hexactin was found in the lectotype while there were several in HCL 395. These may belong to the dermal or atrial hexactin population.

Spicules underlying the dermal, atrial and canalar surfaces are pentactins, rarely stauractins and sometimes the hexactins mentioned above. Pentactins from all parts of the body are identical in range of shape and size. The tangential rays are 0.080-0.448 mm long; the proximal rays are 0.068-0.669 mm long; their diameter near the base is 0.007-0.034 mm. The rays are more or less spinous, but always have dense short spines ornamenting their ends. Pentactins from concave and convex surfaces of specimens HCL 387 and HCL 389 were compared — they are indistinguishable in most dimensions (Table 1).

	1887.10.20.075				HCL 385				HCL 387				HCL 389			
	n	avg	min	max	n	avg	min	max	n	avg	min	max	n	avg	min	max
L pentactin of concave surface, tangential ray									15	.136	.084	.266	15	.188	.106	.289
L pentactin of concave surface, ray proximal									15	.241	.106	.638	15	.334	.137	.441
L pentactin of convex surface, tangential ray									16	.156	.099	.198	16	.181	.129	.220
L pentactin of convex surface, ray proximal									16	.257	.106	.410	16	.336	.122	.418
L dermal and atrial pentactin, tangential ray	26	.146	.084	.220	30	.234	.114	.342	31	.147	.084	.266	31	.184	.106	.289
L dermal and atrial pentactin, ray proximal	26	.305	.068	.593	30	.387	.137	.669	31	.249	.106	.638	31	.335	.122	.441
D discohexaster	24	.046	.031	.065	32	.066	.036	.180	31	.041	.029	.058	30	.043	.032	.061
D dicohexaster's primary rosette	24	.012	.007	.018	32	.009	.004	.022	31	.010	.005	.018	30	.010	.007	.018
D dicohexactin	1	.029	.029	.029	7	.052	.043	.061								
L choanosomal hexactin, ray	25	.069	.032	.152	3	.208	.144	.266	12	.073	061	.084	1	.076	.076	.076

	HCL 388				HCL 392				HCL 372				HCL 396			
	n	avg	min	max	n	avg	min	max	n	avg	min	max	n	avg	min	max
L dermal and atrial pentactin, tangential ray	25	.160	.080	.289	13	.174	.106	.258					15	.228	.129	.448
L dermal and atrial pentactin, proximal	25	.275	.152	.388	13	.313	.190	.418					15	.421	.182	.555
D discohexaster	25	.045	.032	.061	6	.055	.047	.068	8	.090	.076	.122	15	.088	.058	.108
D discohexaster's primary rosette	25	.010	.007	.018	6	.011	.007	.018	8	.017	.011	.022	15	.015	.007	.020
D discohexactin					2	.086	.083	.088	15	.070	.065	.083	1	.072	.072	.072
L choanosomal hexactin, ray	8	.093	.068	.137	3	.058	.038	.084								

TABLE 1. — Some measurements of the spicules of *Euryplegma auriculare* (in mm). L: length. — D: diameter.

Source : MNHN, Paris

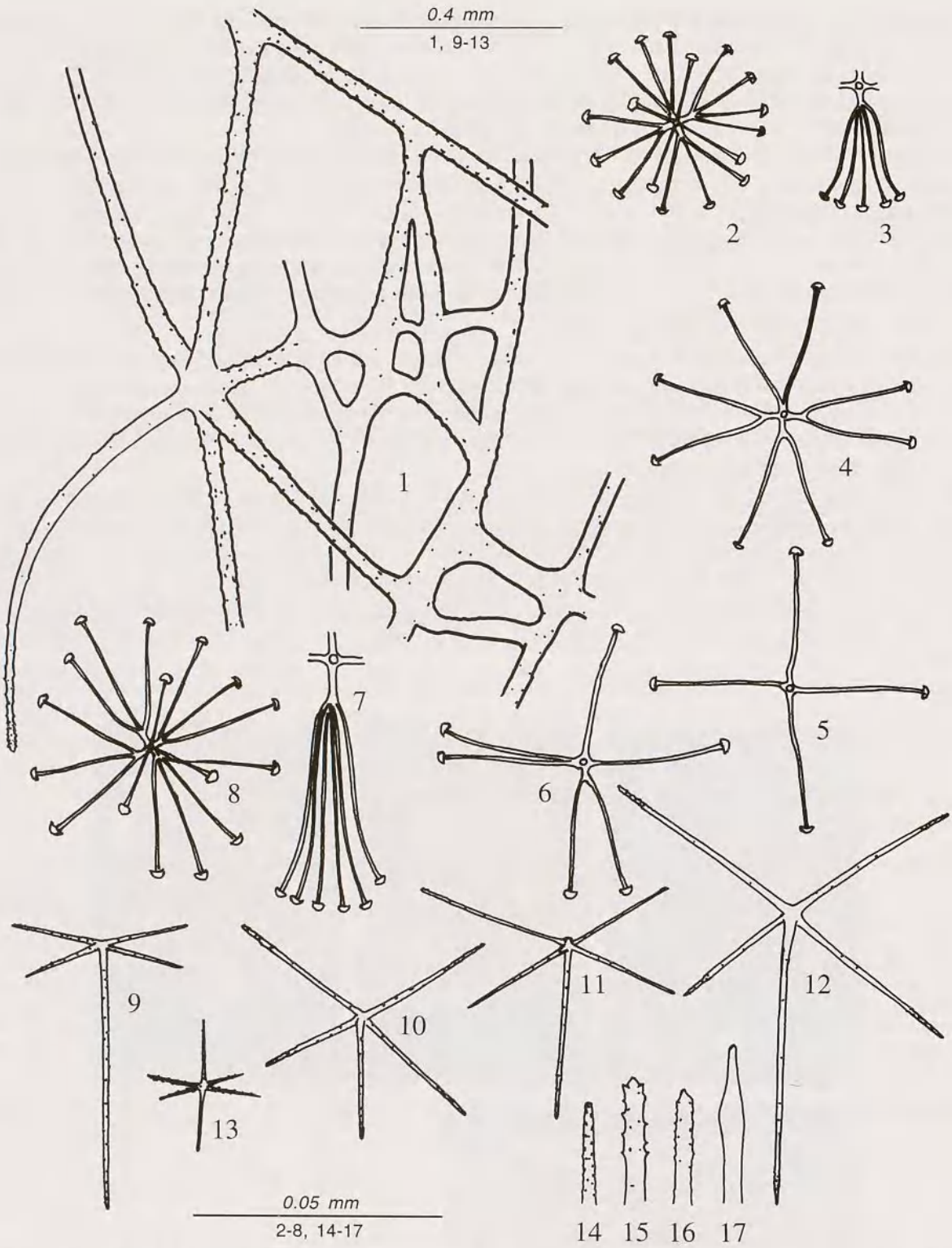


FIG. 13. — Spicules of *Euryplegma auriculare*: **1**, portion of choanosomal aulocalycoid skeleton (MNHN-HCL 395); **2**, spherical discohexaster (NHM 1887.10.20.075); **3**, stellate discohexaster (NHM 1887.10.20.075); **4, 8**, spherical discohexaster (MNHN-HCL 395); **5**, discohexactin; **6-7**, stellate discohexaster (MNHN-HCL 395); **9**, pentactin (NMH 1887.10.20.075); **10-12**, pentactins (MNHN-HCL 395); **13**, choanosomal hexactin (NHM 1887.10.20.075); **14-17**, tips of pentactin tangential rays (MNHN-HCL 395).

Source : MNHN, Paris

Microscleres: Discohexasters usually prevail over the other types of microscleres with discoidal ends — hemidiscohexasters and discohexactins. Regular discohexasters 0.029-0.180 mm in diameter often have stellate form, i.e. their secondary rays are arrayed in rather compact tufts, or they sometimes have secondary rays organized in broad tufts, rendering their external form spherical. Discohexactins 0.029-0.088 mm in diameter are almost absent in the lectotype, rare in some specimens e.g. HCL 392, HCL 396, HCL 395 and predominant in HCL 372. The hemidiscohexasters are rare or entirely absent in most specimens but they were regularly observed in HCL 372. The uncinates (spicules important for taxonomy) found in the type material by REID (1957) were absent in the sponge HCL 372 captured by submersible. It is now possible to confirm the suggestion of REISWIG and TSURUMI (1996) that these spicules have an allochthonous origin.

2. — THE AULOCALYCOID STRUCTURE OF *EURYPLEGMA*

The taxonomic position of *Euryplegma* has been changed many times. SCHULZE (1886) described and first referred his new genus to the family Tretodictyidae, but the next year he (SCHULZE, 1887) reassigned it to the Rossellidae. IJIMA (1898) included *Euryplegma* in his Leucopsacinae, which, at that time, was a subfamily of Rossellidae. Not long after, SCHULZE (1904) again changed the position of the genus, assigning it to the Dactylocalycidae. Later IJIMA (1927) created a new family Aulocalycidae and included the genus *Euryplegma* in it. The features of *Euryplegma*, described by SCHULZE (1887), i.e. the presence of epirhyses and aporhyses, are reflected in IJIMA's differential key characters, but he did not provide a generic diagnosis. LAUBENFELS (1955) proposed a special family, Euryplegmatidae, for this genus but it had no diagnostic difference from the previous Aulocalycidae and thus, no reasonable basis could be found to distinguish it. REID (1957) reinvestigated the type materials and found uncinates, which he considered to be autochthonous, and schizorhyses instead of epirhyses and aporhyses. These features led him to transfer the genus to the family Tretodictyidae. REISWIG & TSURUMI (1996) dismissed the autochthonous nature of the uncinates and changed the diagnosis of Aulocalycidae by adding the possibility of schizorhyses in order to include *Euryplegma* here. With the new specimens, we can now determine the exact set of spicules and confirm the suggestion made by REISWIG & TSURUMI (1996) on the spicules of *Euryplegma*. However, the mode of wall canalization casts doubt on the present taxonomic position of the genus and requires special analysis. Unfortunately the juvenile features and young stages of *E. auriculare* are unknown, hence speculation on the structure of this genus have to be based mainly on theoretical considerations. We present 3 schemes of interpretation of origin and nature of the internal canals of *Euryplegma* (Fig. 14).

IJIMA (1927) interpreted the wall structures of *Euryplegma* as epirhyses and aporhyses, apparently solely on the basis of the description and figure provided by SCHULZE (1887). The structure of the reviewed material does not agree with this interpretation. REID's (1957) opinion, supported by REISWIG & TSURUMI (1996), on the development of true schizorhyses is more reliable (Scheme A, Fig. 14). The initially tubular archetype or unknown ancestor became tongue-like due to asymmetrical growth of a tube's sector. Walls became thicker to provide greater support for an extended body. Thickened walls required elaboration of an internal aquiferous system hence the system of extensive canals were developed. The formation of the tongue-like body which is sickle-like in section, is the result of the increase in longitudinal rigidity of whole sponge. In this case the convex side is dermal while the opposite concave-atrial, similar to other bilateral-symmetrical forms of Hexactinellida. The secondary funnel sometimes, but not always, present in the lower part of a sponge is produced by ingrowth and union of the opposite edges of the a tongue-like growth. This enclosed, narrow, longitudinally-directed slit must be considered, in this scheme, as a parietal osculum. Some objections can be raised against Scheme A (Fig. 14A). All of the internal wall passages observed in sections of *Euryplegma* are lined with pentactins similar to those of the exposed convex and concave surfaces. Are these specific canalaria equivalent to dermal and atrial spicules? Such canalaria are unknown in other Hexactinellida, moreover true schizorhyses are "subdermal canals always covered with dermal layer" (IJIMA, 1927). Thus the interpretation of structure and derivation by Scheme A (Fig. 14), a pattern consistent for Tretodictyidae, does not seem to be applicable to *Euryplegma*.

Scheme B of Fig. 14 suggests an interpretation of body form and canalization by development of schizorhyses which are lined with surface tissues originating from both dermal and atrial layers. This process began with

Source : MNHN, Paris

asymmetrical growth of only a sector of an ancestral tubular form as in the previous scheme (A). Walls of a tongue-like sponge became thicker, its opposite surfaces developed small furrows and depressions which included dermal and atrial layers. Some depressions became connected with those directly opposite and also with internal cavities forming the structure typical of the genus *Euryplegma*. In this case dermal and atrial spicules are situated on the concave and convex surfaces of the tongue-like sponge and, in addition, underlie the linings of the structures similar to schizorhyses. The occurrence of the secondary funnel in the lower part of a body does not change the location of layers of the initial structure. The canal-like structures in this case are not homologous to true schizorhyses of Tretodictyidae and instead are specific aulocalycoid structures, interpretable as tortuous oscula — orifices between dermal and atrial layers. This interpretation is improbable since intermediate forms of such "pseudocanalization" are so far unknown. The primitive canalization of *Tretopleura* with superficial epirhyses and aporhyses is considered unrelated to that of *Euryplegma* and offers no support here. If Scheme B is accepted, then the family Aulocalycidae possesses unique "pseudocanalar" structures.

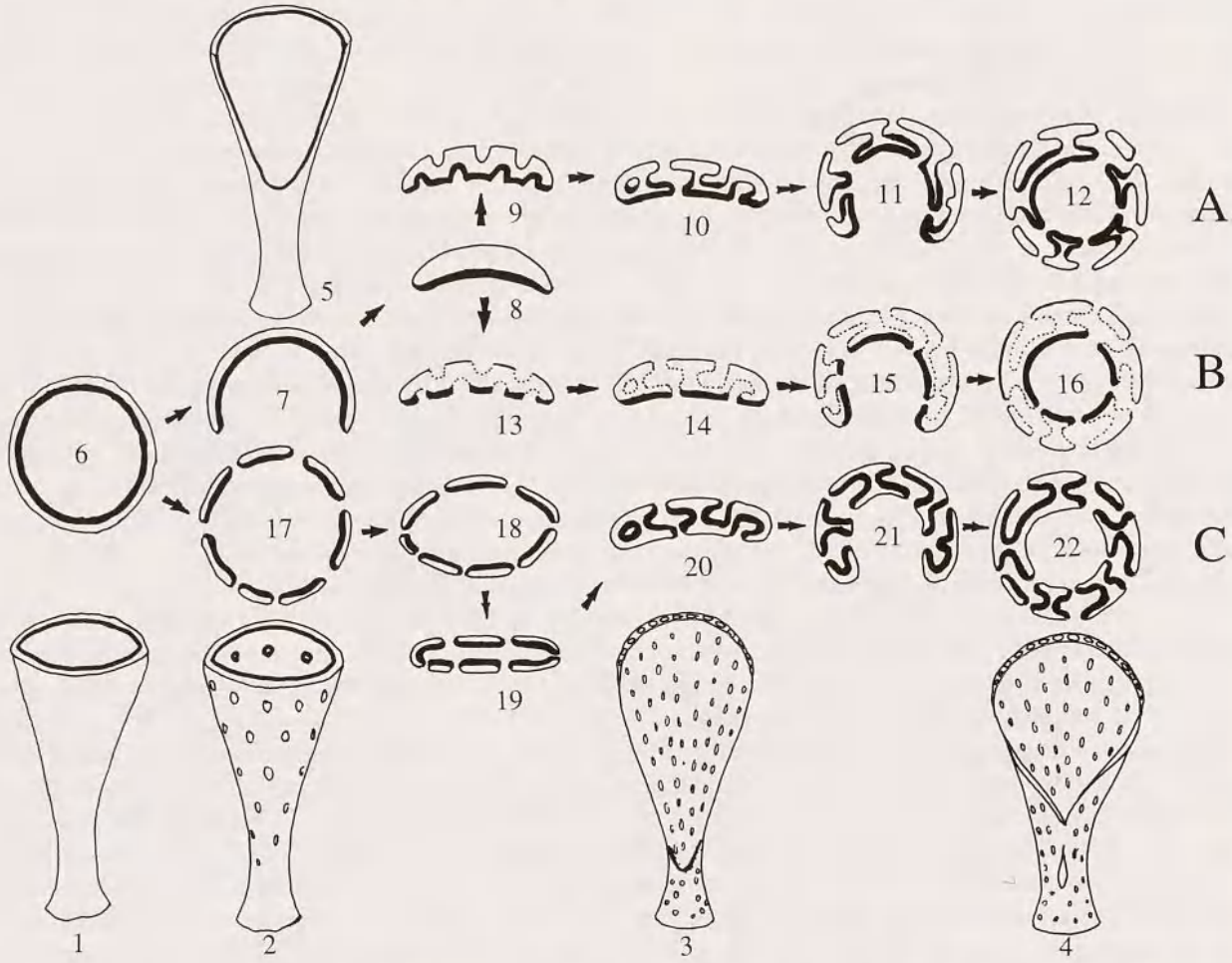


FIG. 14. — Schemes of morphogenesis of *Euryplegma* (thin line: dermalia; thick line: atrialia; dotted line: canalaria): **A**, scheme of development through wall canalization of an asymmetrical form. **B**, scheme of development through wall "pseudocanalization" of an asymmetrical form. **C**, Scheme of development through flattening of a tubular form with lateral parietal oscula and marginal oscula.

1, **6**, hypothetical tubular form, side view and section. **5**, **7**, **9**, **13**, hypothetical tubular form with lateral parietal oscula, side view and section. **2**, **17-19**, hypothetical tubular form with lateral oscula, side view and section. **3**, real tongue-like form, side view. **4**, **10**, **11**, **14**, **15**, 20, **21**, real tongue-like forms with secondary funnel in lower part, side view and upper section. **12**, **16**, **22**, sections through the lower secondary funnel of form 4.

Source : MNHN, Paris

According to Scheme C (Fig. 14) the ancestral tubular form developed numerous lateral parietal oscula. Bilateral compression produced a tongue-like sponge. To increase local rigidity the walls on opposite sides of the atrial surfaces were connected by broad anastomoses. The sickle-like form in transverse section of the tongue-like sponge developed to increase longitudinal rigidity of the entire organism. Also the secondary funnel in the base of some specimens was produced by ingrowth and union of the opposite edges of a tongue-like body. According to this interpretation, the convex and concave (or the inner and the outer) surfaces are lined with dermalia. The parietal slit enclosed in the secondary funnel by union of the ingrown parts is not homologous to a parietal osculum, but is an inter-cavaedium — an entrance into a dermally-lined cavity (term of REID, 1964, for some Euretidae). The atrial cavity in this form must be situated between convex and concave surfaces, subdivided into a system of branching canals. The primary osculum of *Euryplegma* must also be subdivided into numerous apertures at the growing edge of the tongue-like sponge. The functions of the atrial cavity and the oscula have presumably been altered as a result of this major shape change. Water flow might maintain its original pattern, moving into the walls from all exposed surfaces, and transported to the distal edge within the atrial canal system. Alternately water flow might have been grossly modified to pass from one dermal surface to the other across the now internalized atrial cavity, as in the simple ear-like processes of "metameric" claviscopulid described as *Chonelasma* (TABACHNICK, 1988, 1991). These alternatives can only be decided when live specimens are directly examined or specimens with very well-fixed tissues are analyzed histologically.

The three schemes presented should be viewed as hypotheses of possible derivation of the specialized *Euryplegma* body form. At present there is no strong evidence, or known intermediate, to suggest that Scheme C, calling for body flattening and atrial bridging, is more likely scenario than Scheme B. The canals of *Euryplegma* are still termed schizorhyses, with the understanding that they are unlikely to be homologous with the similar canals of the Tretodictyidae.

3. — THE SCOPE OF THE FAMILY AULOCALYCIDAE

The family Aulocalycidae was created by IJIMA (1927). It included 5 genera; *Aulocalyx*, with two species *A. irregularis* Schulze, 1887, and *A. serialis* Dendy, 1916; *Rhabdodictyon*, with two species *R. delicatum* Schmidt, 1880, and *R. kurense* Ijima, 1927, and three monospecific genera, *Tretopleura candelabrum* Ijima, 1927, *Euryplegma auriculare* Schulze, 1886, and *Fieldingia lagettoides* Kent, 1870. Only two taxa were added later: *Tretopleura styloformis* Tabachnick, 1988, and *Leioplegma polyphyllon* Reiswig & Tsurumi, 1996. *R. kurense* was formally transferred to a new genus *Ijimadictyum* Mehl, 1992. The family, according to IJIMA (1927), was determined by an irregular-meshed skeletal framework (later denoted as "aulocalycoid" by REID, 1963); the presence of scopules and uncinates was permitted, as well as epirhyses and aporhyses in *Tretopleura* and *Euryplegma*. The diagnosis of the family given by BARTHEL and TENDAL (1994) was simplified to the aulocalycoid skeleton without any other features and without speculations on the scope of the family. REISWIG and TSURUMI (1996) clarified the misunderstood distinction of the aulocalycoid skeleton and suggested an expanded diagnosis which also allowed uncinates and scopules. Thus the family Aulocalycidae is presently contained within Scopularia and includes forms with a great range of canalization modes where other Scopularia have one special mode, or perhaps two modes, within a family. The mode of canalization is generally regarded as the most significant feature in the family definition - e.g., families Euretidae (sensu IJIMA) or Euretidae and Coscinoporidae (sensu ZITTEL, 1877; BARTHEL & TENDAL, 1994) and Tretodictyidae. Instances of body-form complication by development of inter-cavaedia or atrial expansion in sponges such as *Myliusia* (REID, 1964) are usually not reflected in the diagnosis of families.

Except for the aulocalycoid type of skeleton, there is no other character authentically defining the family. The obligatory presence of dermal and atrial pentactins are common in other Scopularia. From the contributions of IJIMA (1927), MEHL (1992), REISWIG & TSURUMI (1996), the genera recognized until the present as constituents of the Aulocalycidae can be characterized by the following specific features (except choanosomal skeleton and dermal and atrial pentactins):

1. *Euryplegma* - see above.

Source : MNHN, Paris

2. *Aulocalyx* is a tubular stellate form with vertically directed folds bearing lateral oscula; microscleres are distinctive rhopalasters and various discohexasters.

3. *Rhabdodictyon* is a cup-like or tubular sponge with lateral oscula (similar to e.g., *Regadrella* in shape), microscleres are discohexasters, spirodiscohexasters, hemidiscohexasters and discohexactins.

4. *Fieldingia*, as originally described by KENT (1870), is an incomplete sponge represented by a minute and thin lamellar fragment composed of pentactins, rarely stauractins and hexactins; these spicules are fused to each other by tangential rays and numerous synapticulae.

5. *Tretopleura* is a fan-like elongate sponge. Only this genus of Aulocalycidae (*sensu* IJIMA) has epirhyses and aporhyses (IJIMA, 1927), scopules, uncinates and often hexactins (rarely pentactins) among dermalia and atrialia (TABACHNICK, 1988).

6. *Ijimadictyum* is composed of branching and anastomosing tubes provided with additional lateral oscula, microscleres are discohexasters, spirodiscohexasters, hemidiscohexasters and discohexactins.

7. *Leioplegma* is fan-like with dichotomously branching lobate processes; microscleres are discohexasters and hemidiscohexasters.

Loose choanosomal hexactins have been reported from some specimens of *Euryplegma*, from *Aulocalyx serialis* and from *Leioplegma polyphyllon*. It is worth noting that they are always loose, never fused to the aulocalycoid framework.

Of these seven genera, five of them, *Euryplegma*, *Aulocalyx*, *Rhabdodictyon*, *Ijimadictyum* and *Leioplegma*, form a well distinguished group of taxa and it is suggested here that the family Aulocalycidae be limited to this group. An emended family diagnosis, based upon those given by IJIMA (1927) and REISWIG & TSURUMI (1996), is offered here.

DIAGNOSIS OF THE FAMILY AULOCALYCIDAE (from IJIMA, 1927 emended). — Funnel-like, or tubular dichotomously branching-fusing, or fan-like thin-walled sponges with or without lateral oscula. The choanosomal skeleton is of aulocalycoid type — irregular-meshed framework made of hexactins which are orientated irregularly and have elongate rays, usually curved, intersecting at various angles and fusing at intersections and by synapticular junctions. Dermalia and atrialia are pentactins. Canalization is usually lacking but may include unique schizorhyses. Microscleres have spined club ends (rhopalaster) or discoidal ends (discohexasters, hemidiscohexasters and discohexactins).

REMARKS. — The following features seem to be absent in the suggested list of the representatives of the family Aulocalycidae: no sceptrules (scopules or clavules), no uncinates. Except for the schizorhyses canalization of *Euryplegma*, true wall canalization appears to be absent in the other members of the family. Dermalia and atrialia could include some stauractins or even hexactins. Rather small loose choanosomal hexactins could be present within the meshes of the choanosomal framework. The wide spectrum of external body shape does not seem to be an extraordinary feature of Aulocalycidae as it also occurs in the close families, Euretidae and Euplectellidae.

4. — PLACEMENT OF *TRETOPLEURA* AND *FIELDINGIA*

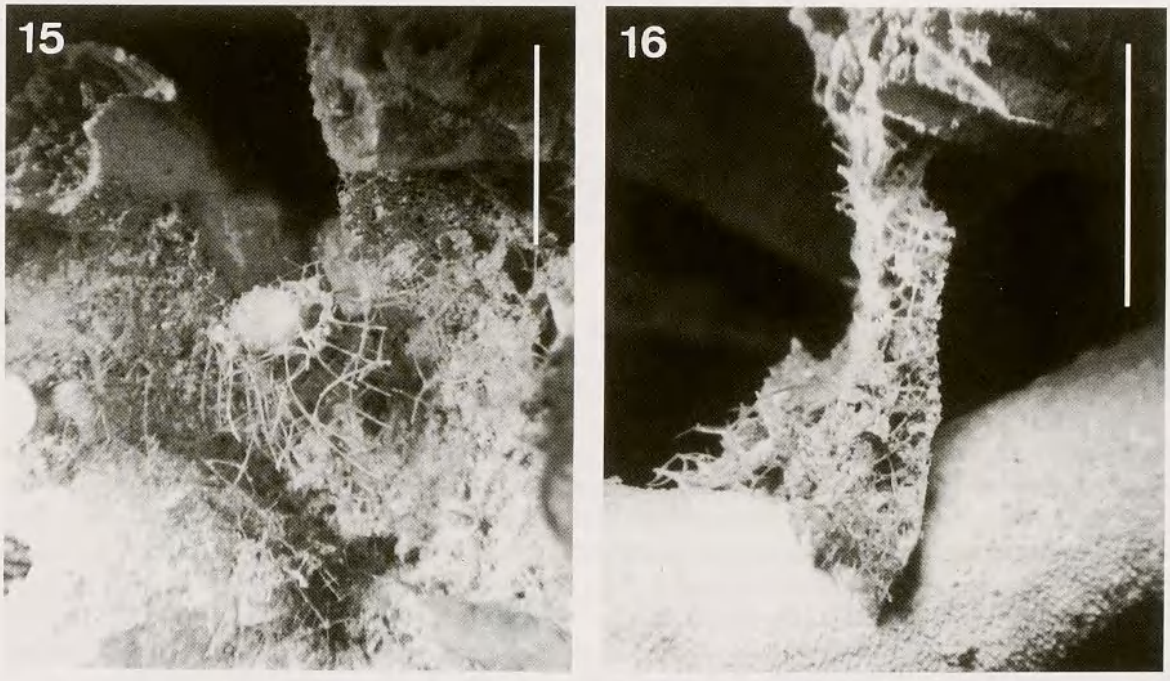
Two genera, *Tretopleura* Ijima and *Fieldingia* Kent, presently members of the family Aulocalycidae, lack the required aulocalycoid choanosomal skeleton. They are to be transferred to other families.

We propose referring *Tretopleura* to the Euretidae (or Coscinoporidae if one chooses to accept division of the former family). Both species of *Tretopleura* have small hexactins fused to the framework similar to representatives of the Euretidae and Farreidae. The genus is poorly investigated and it remains uncertain whether the skeleton of primary regular framework known in the Euretidae/Coscinoporidae representatives (REID, 1958a, 1958b, 1961) can be demonstrated in the type species, *T. candelabrum*. The skeleton in the central, thicker part of *T. styloformis* is fairly regular and may be considered as euretoid. Since the latter is subjectively assigned to *Tretopleura*, its characters cannot be used to set the characters of the genus. The spicule composition and overall body form of *Tretopleura*, necessarily set by its type species, remains unknown; canalization includes extradictyonal epirhyses

Source : MNHN, Paris

and aporhyses. Spiculation, body form and canalization of *T. styloformis* are similar to those of *Bathyxiphus*, differing only in microscleres. We prefer to maintain the genus as a distinct taxon pending finding the type specimen and comparing its characters to those of the other genera of Euretidae.

The genus *Fieldingia* has been described twice. The holotype of *F. lagettoides* is a poor fragment described by KENT (1870) from the Atlantic ocean, the remnants stored as NHM 1872.2.3.178 (Figs 15-17). It does not correspond to the other specimen from the Pacific ocean described under the same species name by SCHULZE (1887), 1887.10.20.127. The characters of the specimen described by KENT are summarized above (3. 4). It is impossible to decide whether junctions between the tangential rays of the dermal pentactins begin as sympodial ray branching, spines produced only in the tangential plane, or simply represent synapticular junctions; these alternatives may only be extreme examples of a continuous spectrum of secondary silicification processes. We cannot even be certain that small stauractins are not involved as well. If this latter feature is true, the skeleton may resemble (in plane view) some skeletons of Reticulosa composed of stauractins of several orders of size. "The largest are arranged so as to enclose square meshes, and the smaller grades lie within these meshes so as to subdivide them regularly" (REID, 1958a) - into so-called "quadrules" (HALL & CLARKE, 1898). In spite of the fact that Reticulosa are considered to be lyssacine sponges, some members of this group may have had spicules cemented together (REID, 1958a).



FIGS 15-16. — *Fieldingia lagettoides*: holotype, attached to coral (scale 5 mm).

Small spherical aggregations of fused hexactins are also sporadically found attached to the main skeleton of *F. lagettoides*. These spherical bodies are similar to the siliceous aggregations which have been reported from diactins of some Rossellidae (e.g., so called "small basidictyonal masses" in *Staurocalyptus glaber* Ijima 1904, pl. 15, fig. 13), and are also likely to have an allochthonous origin.

The specimen described by SCHULZE as a second representative of *F. lagettoides* is a fragment of fused irregular framework of large and small hexaradiate spicules with numerous thick spherical aggregations probably having autochthonous origin. These spherical aggregations must be simple knots of the main spicule framework. The loose spicules are scopules, uncinates, diactins; microscleres are discohexasters, hemihexasters and hexactins. It is impossible to find similarities shared by these fragmentary specimens of KENT and SCHULZE, except for the spherical siliceous bodies which indeed differ in detail in the two forms. Hence SCHULZE's specimen cannot even

Source : MNHN, Paris

be considered a representative of *Fieldingia*. According to its skeleton and spicules, some of which seem to have allochtonous origin, it could not be referred to any existing genus or family and its allocation must await a more detailed analysis of the specimen.

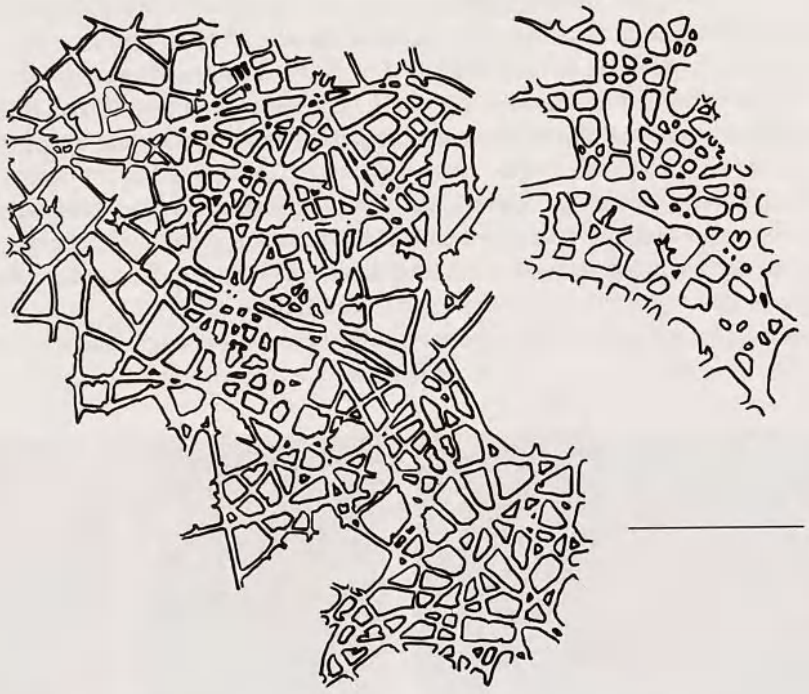


FIG. 17. — "Quadrules" of *Fieldingia lagettoides* (tangential surface). The large spicules are pentactins or hexactins, the small ones are stauractines and synapticulae. This diagram, made from the NHM slide of the holotype described by KENT, resembles the figured skeletons of reticulosans (scale 1 mm).

The holotype of *Fieldingia* is somewhat similar to fossil *Stromatidium* Girty, 1908, which contains a single species — *S. typicale* Girty. It is a cylindrical sponge with one osculum and walls built with several separate layers of rough pentactins fused into a continuous net within each layer. The fusion is formed with dichotomously branching pentactin tangential rays (up to three branchings) and probably with synapticular junctions. Analogous dichotomous branching of tangential rays is described for the dermal pentactins of *Aulochone clathroclada* (family Rossellidae) (LÉVI & LÉVI, 1982). On the photo of a non-type fragment of *S. typicale* (FINKS, 1960, pl. 44, fig. 7), the first inner spicular layer, which must be considered to be juvenile or neanic and which is situated close to the atrial cavity, appears to be composed of fused stauractins. This fact is omitted in the description and should be reviewed in both the photographed non-type fragment and GIRTY's type specimens. Dermal pentactin fusion is known also for Lychniscosa (MEHL, personal communication). FINKS (1960) suggested a new family Stromatidiidae for this unique genus and the family itself is tentatively included into his superfamily Brachiospongioidae. In our opinion both of REID's systems (1958b), one developed chiefly from IJIMA's system and the other from that of SCHRAMMEN, offer more suitable placement for Stromatidiidae. It may be included into the order Reticulosa, characterized as having a skeleton of "coherent or connected megascleres of dermal origin or partly dermal origin" (REID, 1958b). The similarity of *Fieldingia* to *Stromatidium* may be only superficial in that there is an internal dictyonal framework of hexactins in *Fieldingia* but no such component in *Stromatidium* or other Reticulosa. For the present, we consider *Fieldingia* doubtful member of the order Reticulosa, possibly related to Stromatidiidae but not able to be placed within that family on the basis of limited knowledge of both groups. The Reticulosa may be a hexasterophoran group with the same range as Lyssacinosa, Hexactinosa and Lychniscosa or a separate stock with the range equal to Hexasterophora and Amphidiscophora.

Source : MNHN, Paris

5. — THE CLASSIFICATION OF HEXASTEROPHORA

Since the Aulocalycidae are distinguished from the other Hexactinosa by a distinct pattern of framework construction, their removal from that order results in the formation of two coherent and consistent taxa, the Aulocalycoida for the family Aulocalycidae, and the Hexactinosa for the remaining members. The Aulocalycoida should have the same rank as IJIMA's (1927) tribes or REID's (1958b, 1961) orders: Hexactinosa, Lyssacinosa and Lychniscosa. The new taxon, order Aulocalycoida, can be characterized by the diagnosis of Aulocalycidae without specific description of loose spicules. Hence the Aulocalycoida is offered for sponges with specific aulocalycoid skeleton in which uncinates and sceptrules are absent. The diagnosis of the Hexactinosa should be reformed to delimit its scope. Hexactinosa were defined by REID (1958a) as "dictyonina in which the connected hexactins are all simple". Thus sponges with lychniscosan skeletons (all Lychniscosa) and sponges with basidictyonalia (some Lyssacinosa) do not belong to Hexactinosa. The major diagnostic character separating the members of the Hexactinosa from the removed group would be "with farreoid or euretoid type of primary dictyonal skeleton". There is some defense for adding the presence of sceptrules and/or uncinates to the Hexactinosa diagnosis but this would only restrict forms like *Dactylocalyx* Gray, 1867, from this taxon. The modified higher classification of Hexactinellida is presented in Fig. 18.

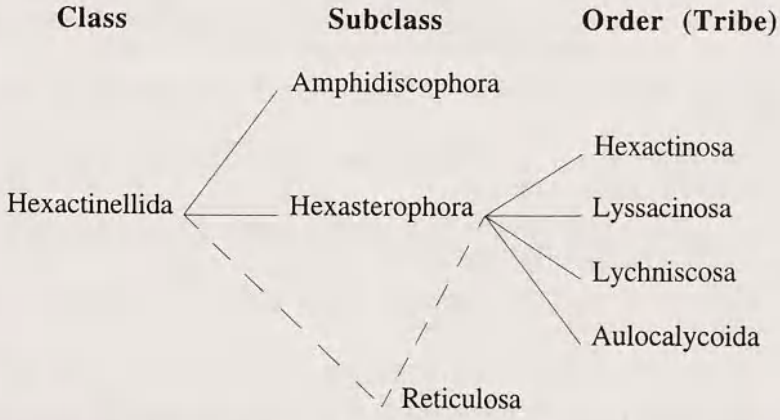


FIG. 18. — Taxonomic scheme of highest taxa of recent Hexactinellida. Complete lines denote well supported relationships; dashed lines indicate uncertain relationships.

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Source : MNHN, Paris

4

Porifera Hexactinellida: Amphidiscophora off New Caledonia

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ABSTRACT

During the "MUSORSTOM" cruises in the southwestern Pacific, and particularly off New Caledonia, 19 species of Hexactinellida Amphidiscophora have been found. Twelve species are considered as new: *Hyalonema spatha, H. uncinata, H. microstauractina, Sericolophus calsubus, S. neocaledonicus, Semperella abyssalis, S. crosnieri, S. varioactina, Poliopogon micropentactinus, P. claviculus, P. zonecus,* and *Pheronema pseudogiganteum.*

Two other new species were collected near Hawaii: *Sericolophus hawaiicus* and off eastern Australia: *Sericolophus cidaricus*. The description of the holotype of *Pheronema giganteum* Schulze is completed.

RÉSUMÉ

Porifera Hexactinellida: Amphidiscophora du large de la Nouvelle-Calédonie.

Au cours de l'examen des collections de spongiaires des campagnes "MUSORSTOM" dans le sud-ouest de l'océan Pacifique, notamment autour de la Nouvelle-Calédonie, 19 espèces d'Hexactinellida Amphidiscophora vivant entre 200 et 3000 m de profondeur ont été identifiées. Douze espèces sont nouvelles : *Hyalonema spatha, H. uncinata, H. microstauractina, Sericolophus calsubus, S. neocaledonicus, Semperella abyssalis, S. crosnieri, S. varioactina, Poliopogon micropentactinus, P. claviculus, P. zonecus* et *Pheronema pseudogiganteum.*

Deux autres espèces nouvelles de *Sericolophus* provenant l'une des Hawaii, *S. hawaiicus*, et l'autre de la côte est de l'Australie, *S. cidaricus*, sont également décrites et la description de l'holotype de *Pheronema giganteum* Schulze est complétée.

TABACHNICK, K. R. & LÉVI, C., 2000. — Porifera Hexactinellida: Amphidiscophora off New Caledonia. *In*: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 21. *Mémoires du Muséum national d'Histoire naturelle*, **184**: 53-140. Paris ISBN 2-85653-526-7.

Source : MNHN, Paris

INTRODUCTION

The Hexactinellida of the southwestern Pacific were almost unknown until the cruise of N/O *"Vauban"* in 1977 off southern New Caledonia (LÉVI & LÉVI, 1982). However, we have two excellent documents on the Hexactinellida of the central Pacific (VON LENDENFELD, 1915) and of Indonesia (IJIMA, 1927). The species from the Japanese coasts are known thanks to IJIMA & OKADA (1938).

The large collections of deep-water fauna (*"Challenger"*,*"Investigator"*,*"Valdivia"*,*"Galathea"*) do not include sponges from this area, except two species collected by the *"Challenger"* near the Kermadec Islands.

The many French oceanographic expeditions around New Caledonia since 1985, obtained an interesting collection of Hexactinellida Amphidiscophora rich in new species, which are the objective of this study.

The systematic study of Hexactinellida is still very difficult because of the small number of collected specimens. Most of the described amphidiscophoran species are defined from a single specimen and sometimes from fragments. If most of the genera are well defined, taxonomy at the species level is rather approximative, and the degree of intraspecific variability is unknown. The works of VON LENDENFELD (1915), based on a very rich photographic documentation, show the variability of spicular characteristics. Expecting results of the comparative analysis of isoenzymes and nucleotide sequences, the taxonomist must underscore the observed morphological variants. The description of atypical, abnormal shapes and the indications of presence vs absence or differences in spicule densities lead to an artificial grouping of specimens into temporary "species".

Collection of Amphidiscophora from the "MUSORSTOM" expeditions mainly around New Caledonia and in other areas of the southwestern Pacific is similar to the better known collection from the Indian Ocean. It is, however, too early to extract pertinent biogeographical information and to determine its major and original characteristics. This will be easier to achieve when all Hexactinellida genera have been studied.

The collection of Amphidiscophora contains 18 species, including 12 new species. Two other new species: *Sericolophus hawaiicus* and *Sericolophus cidaricus* came respectively from Hawaii and the Eastern coast of Australia. The type specimen of *Pheronema giganteum* Schulze (stored in the BNMH) has been redescribed.

Information on the cruises where the samples studied here were collected can be found in:
— RICHER DE FORGES (1990) for BIOCAL, BIOGEOCAL, CHALCAL 2, MUSORSTOM 4, 5 and 6, SMIB 1 and 4;
— RICHER DE FORGES & MENOU (1993) for MUSORSTOM 7;
— ROUX (1994) for CALSUB;
— RICHER DE FORGES & CHEVILLON (1996) for BATHUS 4;
— GRANDPERRIN *et al.* (1997) for HALIPRO 2.

No published reports are known concerning CIDARIS 1 and HURL 88 and 92.

When no place of deposit is specified, the material is in the collection of the Muséum national d'Histoire naturelle (MNHN).

The abbreviations for the institutions whose collections were used in this study are as follows:

BPBM - Bernice P. Bishop Museum, Honolulu.
IORAN - Institute of Oceanology, Russian Academy of Sciences, Moscow.
MTQ - Museum of Tropical Queensland, Townsville, Australia.
NHM - The Natural History Museum, London [formerly the Bristish Museum (Natural History)].
USNM - National Museum of Natural History. Smithsonian Institution, Washington.
ZMA - Zoölogisk Museum, Amsterdam.

In the list of material examined, the capital letters preceding the station number refer to the gear used: DC: Charcot dredge; DW: Warén dredge; CP: beam trawl; CC: shrimp otter trawl; BT: benthic fish trawl.

The research vessels' names are in italics, quoted in commas.

Source : MNHN, Paris

LIST OF SPECIES

The new species are in bold.

AMPHIDISCOPHORA F.E. Schulze, 1886

I. Family HYALONEMATIDAE J.E. Gray, 1857

Genus ***HYALONEMA*** J.E. Gray, 1835

Hyalonema (Leptonema) spatha sp. nov.
Hyalonema (Onconema) uncinata sp. nov.
Hyalonema (Pteronema) topsenti Ijima, 1927
Hyalonema (Oonema?) microstauractina sp. nov.
Hyalonema (Cyliconema) pateriferum Wilson, 1904

II. Family MONORHAPHIDIDAE Ijima, 1927

Genus ***MONORHAPHIS*** F.E. Schulze, 1904

Monorhaphis chuni F.E. Schulze, 1904

III. Family PHERONEMATIDAE J.E. Gray, 1872

Genus ***SERICOLOPHUS*** Ijima, 1901

Sericolophus calsubus sp. nov.
Sericolophus neocaledonicus sp. nov.
Sericolophus hawaiicus sp. nov.
Sericolophus cidaricus sp. nov.

Genus ***SEMPERELLA*** J.E. Gray, 1868

Semperella schultzei (Semper, 1868)
Semperella varioactina sp. nov.
Semperella abyssalis sp. nov.
Semperella crosnieri sp. nov.

Genus ***POLIOPOGON*** Wyville Thomson, 1873

Poliopogon micropentactinus sp. nov.
Poliopogon claviculus sp. nov.
Poliopogon zonecus sp. nov.

Genus ***PHERONEMA*** Leidy, 1868

Pheronema pilosum Lévi, 1964
Pheronema semiglobosum Lévi & Lévi, 1982
Pheronema conicum Lévi & Lévi, 1982
Pheronema giganteum F.E. Schulze, 1887
Pheronema pseudogiganteum sp. nov.

Source : MNHN, Paris

DEPTH DISTRIBUTION

The depth ranges where the species were found are given below.

Species	Depth
Pheronema semiglobosum Lévi & Lévi	235-800 m (highest density 400 m)
Pheronema conicum Lévi & Lévi	310-610 m (highest density 410 m)
Semperella schultzei Semper	370-580 m
Hyalonema topsenti Ijima	550-602 m
Sericolophus calsubus sp. nov.	516-880 m
Pheronema pseudogiganteum sp. nov.	540-1000 m (1620 ?)
Hyalonema spatha sp. nov.	760-970 m
Sericolophus neocaledonicus sp. nov.	700-1480 m
Semperella varioactina sp. nov.	? -1070 m
Monorhaphis chuni Schulze	825-1070 m
Semperella crosnieri sp. nov.	800-1240 m
Poliopogon zonecus sp. nov.	697- 1380 m
Poliopogon claviculus sp. nov.	1100-1380 m
Pheronema pilosum Lévi	825-1620 m
Hyalonema microstauractina sp. nov.	1015-1620 m
Poliopogon micropentactinus sp. nov.	1395-2160 m
Hyalonema uncinata sp. nov.	2370-2375 m
Hyalonema pateriferum Wilson	2380-2697 m
Semperella abyssalis sp. nov.	2960-3036 m

The mean bottom temperatures and salinities observed were:

Depth	Bottom temperature	Bottom salinity
400 m	13°C	35.1 ‰
600-800 m	7°C	34.4 ‰
800-1000 m	5°C	34.5 ‰
2000 m	2°C	34.6 ‰

SYSTEMATIC ACCOUNT

Family HYALONEMATIDAE Gray, 1857

Genus ***HYALONEMA*** Gray, 1835

Subgenus ***LEPTONEMA*** von Lendenfeld, 1915

DIAGNOSIS (IJIMA, 1927). — Dermal pinular ray short-spiny and whip-like, up to 0.800 mm long or shorter (up to 0.300 mm long) and either short spiny or moderately long-spiny and narrowly plumose in appearance; rachis thickest at base. Choanodermal macrohexactin and intermedial microhexactin generally present. Without ambuncinate. Largest macramphidisc relatively narrow, with umbel longer than broad. Sponge with or without oscular sieve plate or a covering layer to sunken gastral surface.

Source : MNHN, Paris

TYPE SPECIES. — *H. campanula* von Lendenfeld, 1915.

Hyalonema (Leptonema) spatha sp. nov.

Fig. 1-6; Tab. 1

MATERIAL EXAMINED. — **New Caledonia**. BIOCAL: stn CP 31, 23°08.70'S, 166°51.55'E, 850-1005 m, 29.08.1985: HCL 495. — Stn CP 54, 23°10.08'S, 167°43.54'E, 950-1000 m, 1.09.1985: HCL 420-421. — Stn CP 75, 22°42'S, 167°23.41'E, 825-860 m, 4.09.1985: HCL 416-419.

HALIPRO 2: stn BT 066, 24°44.86'S, 168°29.39'E, 885 m, 19.11.1996: HCL 422.

Loyalty Islands. BIOGEOCAL: stn CP 290, 20°36.91'S, 167°03.34'E, 920-760 m, 27.04.1987: HCL 415.

CALSUB: stn 7, W of Lifou Island and N of Santal Bay, 20°48'S, 167°05'E, 970-489 m, 24.02.1989: HCL 413, 414.

TYPES. — *Holotype*: HCL 413 (CALSUB, stn 7, W of Lifou Island and N of Santal Bay, 20°48'S, 167°05'E, 970-489 m).

Paratypes: all the other specimens cited above.

DESCRIPTION. — The holotype (fig. 1-2) is cone-like, 100 mm long, with a slightly convex atrial surface and a short apical cone. The diameter of the lower part is 15 mm, the maximum diameter of 65 mm is between dermal and atrial surfaces. Basalia are twisted in a tuft over 60 mm long, about 7 mm in diameter. The body shape of the paratypes varies: they are all bell-like whereas the atrial surface is flat (HCL 417) (fig. 3) or slightly concave (HCL 414) (fig. 1-4). The canalar-like depressions on atrial surface are numerous and small in HCL 417, restricted to 5 and deeply penetrating the body in HCL 414. The length of the body of paratypes is 50-80 mm, the diameter 15-90 mm.

Spicules: The choanosomal skeleton consists of smooth diactins (fig. 6.10) 0.6-1.6/0.006-0.008 mm with a widening medially. Prostalia lateralia (fig. 6.11) are pinular diactins, with four rudimental tubercles in the middle. Pinular ray 0.21-0.43/0.014 mm similar to dermal or atrial pentactins but the finely pointed ends do not protrude far beyond the last spines. The ray directed inside the body 0.07-0.38/0.012-0.014 mm is smooth, sometimes with rare short spines. These pinular diactins are often found among the dermal and atrial spicules. All the anchorate basalia (if present) are broken and their ends are unknown. Dermalia and atrialia are pinular pentactins, rarely hexactins. The base of the pinular ray is thickest at the base. Pinular ray of dermalia (fig. 6.1) 0.085-0.380/ 0.004 mm, the tangential rays are 0.019-0.060/0.003 mm. The pinular ray of atrialia (fig. 6.2-3) is 0.074-0.270/0.004 mm, tangential rays 0.019-0.050/0.003 mm. The whip-like ends of the pinular rays freely project far beyond the last spine. The tangential rays are usually smooth, sometimes with spaced short spines. Hypodermal and hypoatrial pentactins (fig. 6.12) have smooth rays 0.09-0.33/0.015-0.038 mm, the ray directed inside the body is usually longer than tangential ones.

Microstauractins (fig. 6.4-9) are sword-like, with rays covered with dense spines, three rays are short 0.008-0.026/0.003 mm and one is long 0.044-0.145/0.003 mm. Two rays of these stauractins are sometimes long, rarely all four rays are short and a spicule is similar to stauractin acanthophore of some other representatives of *Hyalonema* or very rarely these spicules have form of paratetractin.

The amphidiscs (fig. 6.13-14) fall into two groups, despite of some overlap of maximal length of micramphidiscs and minimal length of macramphidiscs. They are sometimes hardly distinguished from each other in shape and size. Nevertheless, most of them are well distinguished by size classes and the macramphidiscs often have umbels more elongate than the micramphidisc (fig. 6.15) which umbels are nearly equal in length and diameter. The macramphidiscs are rare in the specimen HCl 415. Total length of macramphidiscs 0.025-0.148 mm, umbel length 0.008-0.063 mm, umbel diameter 0.008-0.059 mm. Total length of micramphidiscs 0.014-0.041 mm, umbel length 0.004-0.015 mm, umbel diameter 0.005-0.013 mm. Shafts of macramphidiscs and micramphidiscs covered with spines. Several macramphidiscs, probably of foreign origin, were found in one specimen. They have very long teeth which cross the equator and overlap with the opposite teeth. One huge macramphidisc, probably foreign too, 0.315/0.111/0.104 mm, was found in specimen HCl 415.

Source : MNHN, Paris

ETYMOLOGY. — The specific name alludes to the shape of microholactine spicules.

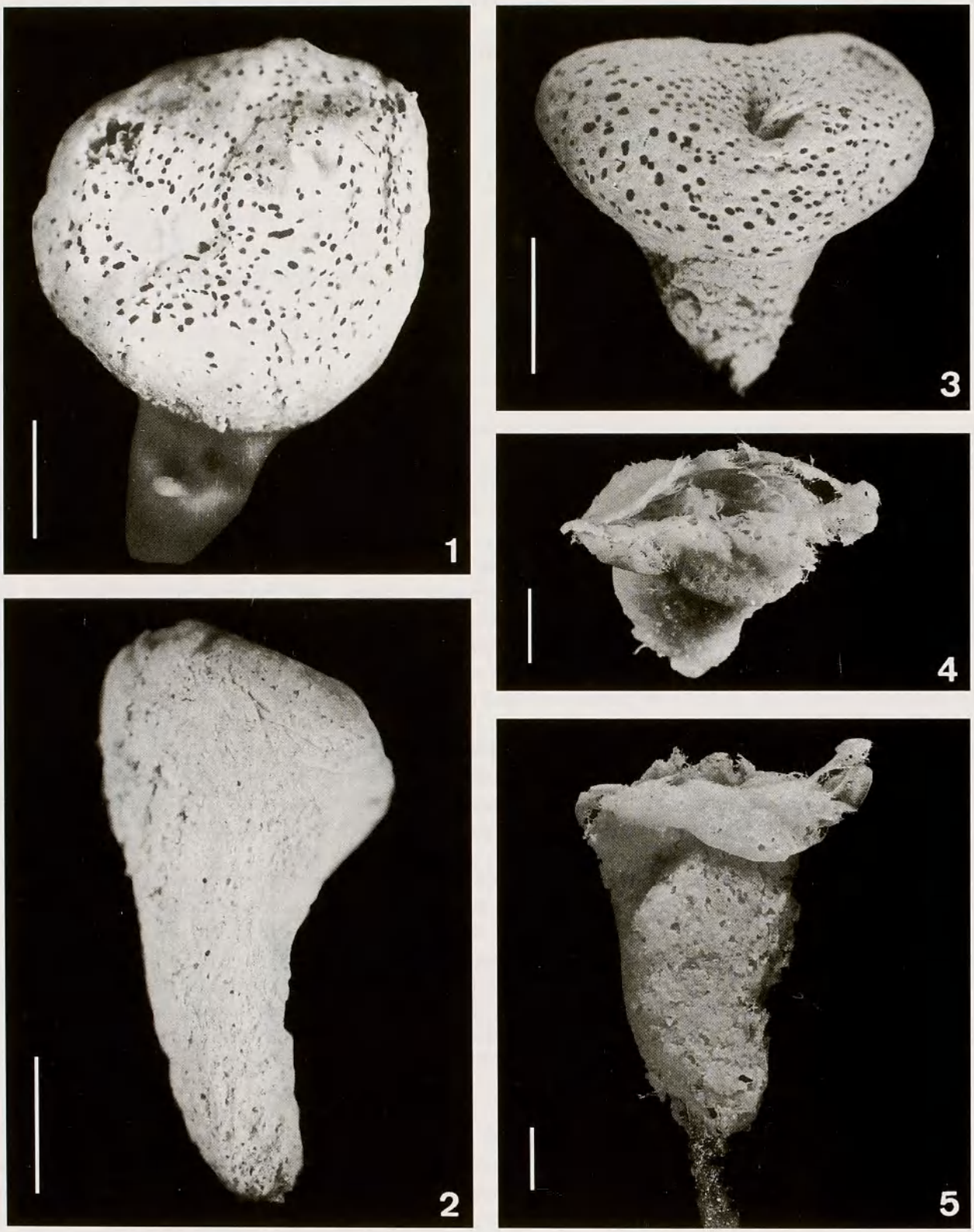

FIG. 1-5. — *Hyalonema (Leptonema) spatha* sp. nov.: **1-2** (HCL 413); **3** (HCL 417); **4-5** (HCL 414). Scales = 2 cm.

Source : MNHN, Paris

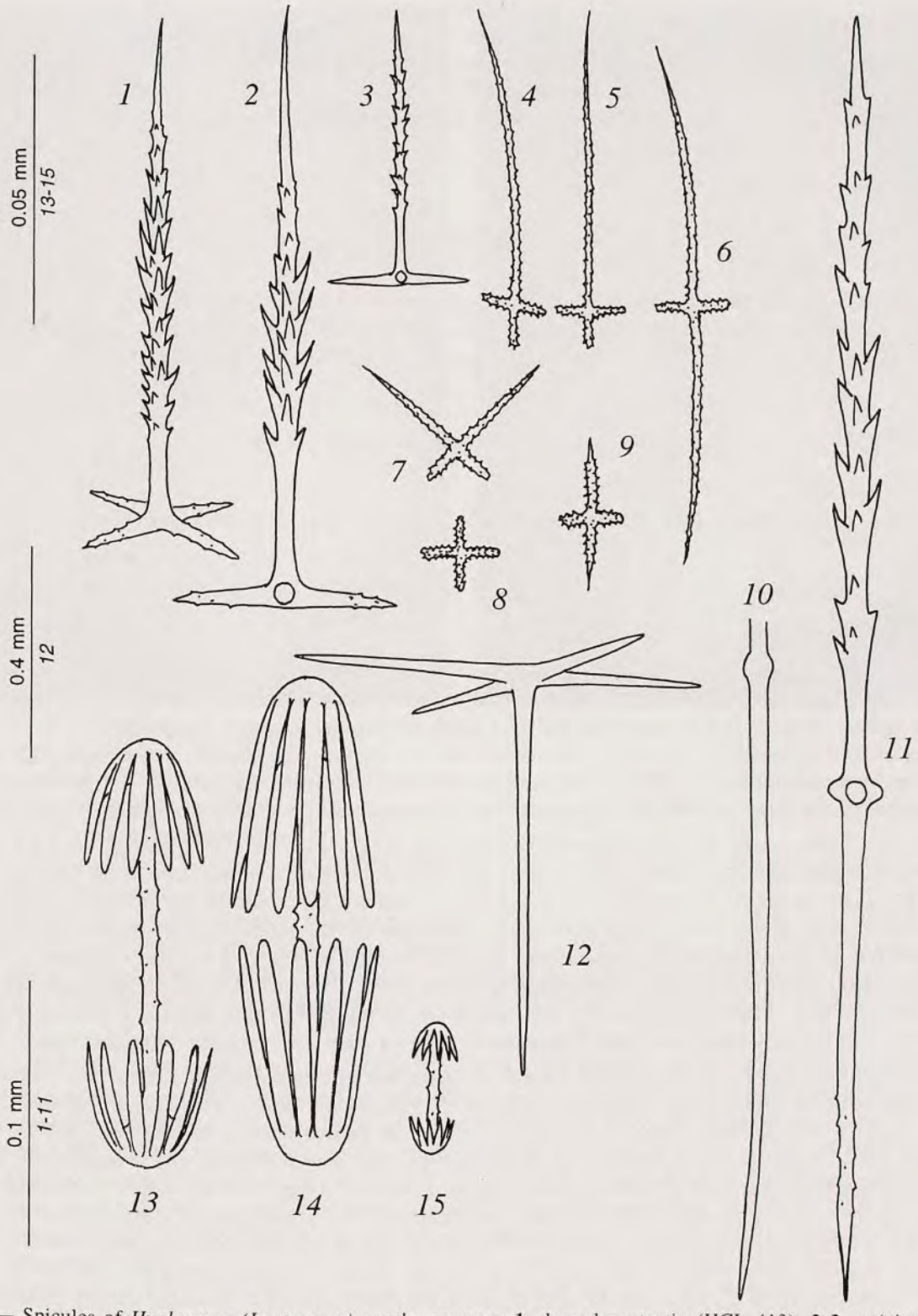

FIG. 6. — Spicules of *Hyalonema (Leptonema) spatha* sp. nov.: **1**, dermal pentactin (HCL 413); **2-3**, atrial pentactins (HCL 413); **4-6**, microstauractins (HCL 413); **7-9**, microstauractins (HCL 418); **10**, choanosomal diactin (HCL 413); **11**, prostalia lateralia - pinular diactin (HCL 413); **12**, hypodermal pentactin (HCL 413); **13**, macramphidisc (HCL 413); **14**, macramphidisc (HCL 417); **15**, micramphidisc (HCL 413).

Source : MNHN, Paris

REMARKS. — The species is referred to the subgenus *Leptonema*. The most outstanding feature of the new species is the presence of sword-like stauractins. In several species of Amphidiscophora the derivatives of hexactins to monactins are usually known as additional to the hexactins or pentactins spicules (for example *Semperella schultzei*) (MARSHALL & MEYER, 1879). Another species of the amphidiscophoran family Hyalonematidae, *Lophophysema australicum* sp. nov., has mainly whip-like monactins (TABACHNICK & LÉVI, 1999).

Subgenus ***ONCONEMA*** Ijima, 1927

DIAGNOSIS. — Choanosomal macrohexactins and microhexactins always present. Pinular pentactins with relatively short distal ray, terminating with an apical cone. Macramphidiscs with umbels slightly shorter than 1/3 the whole length of the spicules. Uncinate rhabdoxydiactins in the peripheral parts of the body.

Hyalonema (Onconema) uncinata sp. nov.

Fig. 7-9; Tab. 2-3

MATERIAL EXAMINED. — **New Caledonia**. BIOGEOCAL: stn CP 283, 21°22.25'S, 166°31.07'E, 2375-2370 m, 26.04.1987: HCL 423-424.

TYPES. — *Holotype*: HCL 424 (BIOGEOCAL, stn CP 283, 21°22.25'S, 166°31.07'E, 2375-2370 m).
Paratype: HCL 423.

DESCRIPTION. — The holotype (fig. 7-8) is similar in shape to *H. (Onconema) agassizi* "form A" (LENDENFELD, 1915, pl. 41.2) and to *H. (Onconema) obtusum* var. *gracilis* (LENDENFELD, 1915, pl. 33.16). The body is oval or lemon-like, 17 mm long and 17 x 8 mm in maximal diameter. The apical cone is surrounded by a circular wall which ends in a narrow frill, with a circular margin. The circular wall is separated from the apical cone by a circular fissure which is the atrial cavity. The outer surface is smooth. The paratype is more damaged than the holotype and measures approximately 18 mm long and about 10 x 4 mm in diameter.

Spicules: Choanosomal skeleton of smooth diactins (fig. 9.11-12), 0.5-1.7/0.004-0.019 mm with or without medial widening. Uncinates diactins (fig. 9.6-7) with medial widening and uncinates monactins (fig. 9.8,10) without any widening are 0.3-0.7/0.004-0.090 mm. Some of these spicules could be considered as ambuncinates; they have very short spines, which seem to be bent to the center of the spicule. The uncinates diactins are rare in the holotype and abundant in the paratype, the opposite situation is observed with the uncinates monactins. The special description of the types of uncinates is given in the "REMARKS" later. Choanosomal hexactins are smooth with rays, 0.18-0.36/0.008-0.015 mm, which can be unequal in each spicule. Dermalia and atrialia are pentactins, very rarely hexactins. Dermal pentactins can be separated into two types. The first type is a pinular pentactin (fig. 9.1) which has the pinular ray 0.076-0.137/0.004 mm, thickest at base, with long or rarely short spines and thin, whip-like end which protrudes far beyond the last spines. The tangential rays are covered with dense short spines, they are 0.030-0.091/0.004 mm. These spicules are similar to the dermal, pinular pentactins from the lower part of the body of *H. (Onconema) agassizi* (Lendenfeld, 1915). The second type which is also considered to be dermal pentactins (fig. 9.2-3) are spicules with nearly equal rays, 0.084-0.122/0.004 mm, similar to the tangential rays of dermal pentactins. Similar spicules were described in *H. (Onconema) agassizi* as minute pentactins. Furthermore, the rays of acanthophores in *H. (Onconema) obtusum* are similar in shape to the second type of dermal pentactins of *H. (Onconema) uncinata*. The atrial pinular pentactins (fig. 9.4) differ strongly from the dermal ones. The pinular ray 0.129-0.167/0.014 mm is spindle-like, often thickest in the middle, with relatively short spines, the end has an apical cone. The tangential rays 0.019-0.034/0.006 mm are short, usually with sparse small spines or entirely smooth. Their ends are rounded or finely pointed.

Source : MNHN, Paris

FIG. 7-8. — *Hyalonema (Onconema) uncinata* sp. nov. (HCL 424). Scales = 1 cm.

The hypodermal and hypoatrial pentactins have smooth rays, 0.14-0.68/0.006-0.038 mm, the ray directed inside the body is usually longer than the tangential ones. The tangential rays can be of different length and sometimes with unusual spherical ends.

Microhexactins (fig. 9.17) have 0.023-0.065/0.002 mm rays. The rays are covered with dense minute spines and often they have curved ends, or rarely straight.

Amphidiscs fall into two groups: Macramphidiscs (fig. 9.15) are 0.236-0.334 mm long, umbel 0.084-0.122 mm long and 0.061-0.099 mm in diameter. The shaft has a whorl of spines in the middle and some spines in other places. Umbel's teeth have lancet-like ends. Total length of micramphidiscs (fig. 9.16), 0.014-0.032 mm, umbel length 0.004-0.011 mm, umbel diameter 0.005-0.007 mm. Shafts of micramphidiscs smooth or covered with spines.

REMARKS. — This species belongs to the subgenus *Onconema* Ijima. A great similarity is found between this and previously described species: *Hyalonema (O.) agassizi and H. (O.) obtusum* known from the central-eastern Pacific at 4069-4504 m depth (LENDENFELD, 1915). The new species is closer to *H. (Onconema) agassizi* than *H. (O.) obtusum*. The diagnostic feature of the new species is the presence of dermal pentactins with pinular ray thickest at the base and with whip-like outer end. Among other peculiarities is the narrower range of variation of both types of amphidiscs. Each type of macramphidisc and micramphidisc of LENDENFELD's species is divided into two size classes, which notably overlap by the borders. Atrial pinular pentactins of *H. (Onconema) uncinata* are dissimilar to other species due to the proportion of their rays and slighter because of their measures. The measures of other spicules in all known species of the subgenus *Onconema* have similar parameters.

ETYMOLOGY. — The species name refers to the presence of the uncinate spicules.

Source : MNHN, Paris

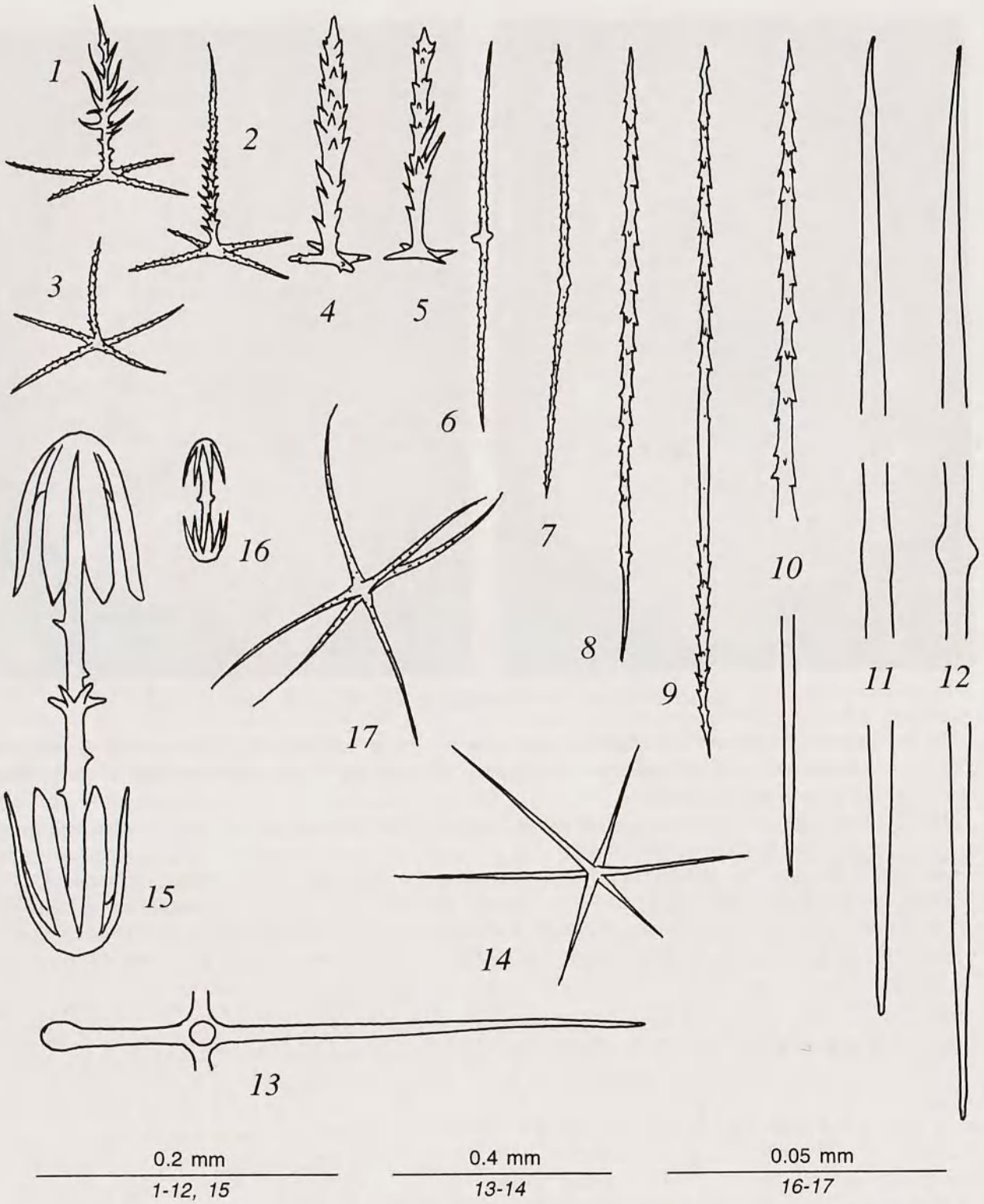

FIG. 9. — Spicules of *Hyalonema (Onconema) uncinata*. sp. nov.: **1**, dermal pinular pentactin (HCL 424); **2-3**, dermal pentactin (HCL 424); **4**, atrial pinular pentactins (HCL 424); **5**, atrial pinular pentactins (HCL 423); **6-7**, uncinates diactin (HCL 424); **8**, **10**, uncinates (HCL 424); **9**, ambuncinate (HCL 424); **11-12**, diactins (HCL 424); **13**, hypodermal pentactin with different rays (HCL 424); **14**, choanosomal hexactin (HCL 424); **15**, macramphidisc (HCL 424); **16**, micramphidisc (HCL 424); **17**, microhexactin (HCL 424).

Source : MNHN, Paris

Subgenus ***PTERONEMA*** Ijima, 1927

DIAGNOSIS. — Dermal pinular ray plumose or with moderately long lateral spines giving a conical or spindle-like shape to their entire ray under 0.170 mm length. Rachis thickest at base. Ambuncinate present. Microholactin hexactin sometimes pentactin and stauractin. Macramphidiscs with umbel broader than long.

Hyalonema (Pteronema) topsenti Ijima, 1927

Fig. 10-12; Tab. 4

Hyalonema (Pteronema) topsenti Ijima, 1927: 61, pl. 1 fig. 5-6, pl. 2 fig. 11, pl. 3 fig. 1-10.
Hyalonema topsenti - LÉVI & LÉVI, 1989: 36, fig. 5.

FIG. 10-12. — *Hyalonema (Pteronema) topsenti* Ijima, 1927 (HCL 425). Scales = 2 cm.

MATERIAL EXAMINED. — **New Caledonia**. Dragages *"Vauban"*: stn 39, dragage 9, 22°29'S, 166°23'E, 375-550 m, 7.06.1978: HCL 427.
CALSUB: stn 9, 20°53'S, 167°03'E, 602 m, 27.02.1989: HCL 425.
BATHUS 4: stn CP 892, 21°01'S, 164°27'E, 580-602 m, 2.08.1994: HCL 426.
Loyalty Islands. MUSORSTOM 6: stn CP 490, 20°48.88'S, 167°06.13'E, 750 m, 24.02.1989: HCL 428. — Stn DW 493, 20°48.35'S, 167°05.80'E, 700 m, 25.02.1989: HCL 429.

Source : MNHN, Paris

DESCRIPTION. — The complete specimens are HCL 425 and HCL 426. The first is oval, 55 mm long and 25 x 20 mm in maximal diameter. The section is nearly quadrangular and the surface seems divided in four longitudinal areas: 55 x 20-25 mm. The dermal lattice is similar to *Hyalonema globus* Schulze. The atrial cavity is not apparent. Under the convex apical surface, four subatrial canals penetrate vertically deep inside the body. Basalia are 100-120 mm long and covered with strong spines or denticular ridges like in *Cholaronema sibogae* Ijima. This sponge HCL 425 shares several characters with *Hyalonema topsenti* Ijima and *Hyalonema globus* Schulze. IJIMA (1927) already suggested a close affinity between these species.

REMARKS. — Most generally, these sponges are very similar to specimens of the same species described by IJIMA (1927) from the Indonesia and by LÉVI & LÉVI (1989) from the Philippine Islands.

The external shape of this species displays a high variability: presence of apical cone in one specimen and atrial depression in another. This variation is large enough and may be rather observed among related species than between intraspecific populations. All specimens are nearly identical in spicule content despite being collected far from each other. The specimens off New Caledonia have micropentactins and microstauractins instead of microhexactins, which the previously known specimens exhibited.

DISTRIBUTION. — Indonesia, Philippines, New Caledonia.

Hyalonema (Oonema?) microstauractina sp. nov.

Fig. 13-16; Tab. 5

MATERIAL EXAMINED. — **New Caledonia**. BIOCAL: stn CP 57, 23°44.51'S, 166°54.94'E, 1490-1620 m, 1.09.1985: HCL 430. — Stn CP 60, 23°58.87'S, 167°07.72'E, 1530-1480 m, 2.09.1985: HCL 432 et 433. — Stn CP 61, 24°10.67'S, 167°33.65'E, 1070 m, 2.09.1985: HCL 431.

BIOGEOCAL: stn CP 214, 22°43.09'S, 166°27.19'E, 1665-1590 m, 9.04.1987: HCL 435.

Wallis and Futuna Islands. MUSORSTOM 7, stn CP 564, 11°46.10'S, 178°27.40'W, 1015-1020 m, 20.05.1992: HCL 434.

TYPES. — *Holotype*: HCL 432 (BIOCAL, stn CP 60, 23°58.87'S, 167°08.43'E, 1530-1480 m).

Paratypes: all the other specimens mentioned above.

DESCRIPTION. — The holotype is conical, with very shallow (slightly depressed) atrial cavity, 60 mm long and 40 x 50 mm in maximal diameter. The paratypes are similar to the holotype in shape and size; they are 45-70 mm

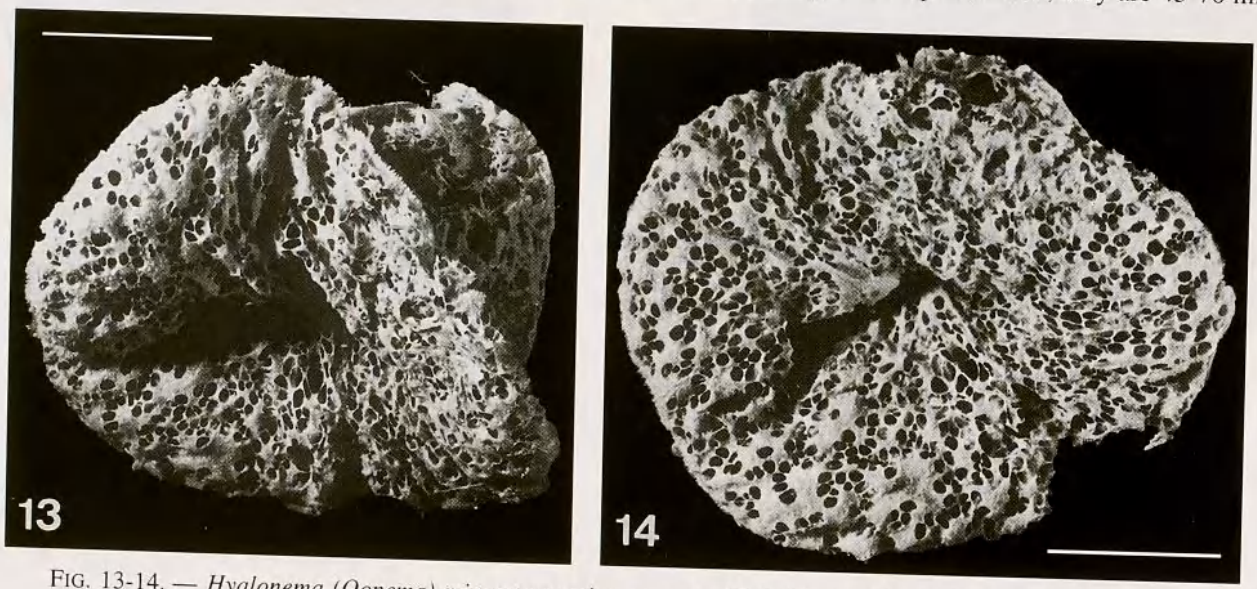

FIG. 13-14. — *Hyalonema (Oonema) microstauractina* sp. nov.: **13** (HCL 430); **14** (HCL 435). Scales = 2 cm.

Source : MNHN, Paris

long and 40-70 mm in diameter. The paratype HCL 433, which contains the greatest number and variation of macramphidiscs, is a thin lamellar fragment 45 x 75 mm. No notable canals were observed beneath the atrial surface.

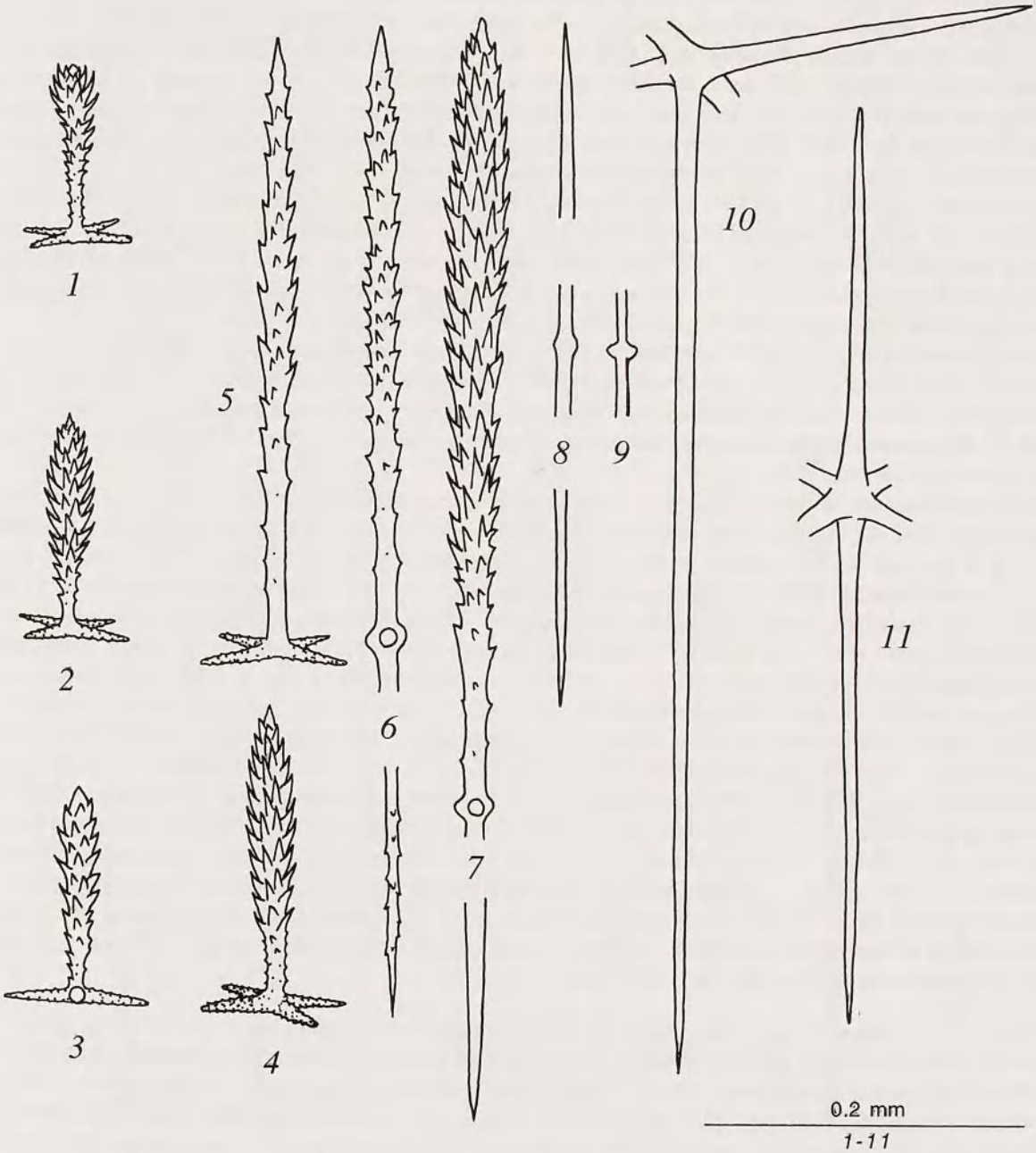

FIG. 15. — Spicules of *Hyalonema (Oonema) microstauractina* sp. nov.: **1-2**, small dermal pentactins (HCL 433); **3-4**, small atrial pentactins (HCL 433); **5**, large dermal pentactin (HCL 433); **6**, dermal pinular diactins (HCL 433); **7**, dermal pinular diactins (HCL 432); **8-9**, choanosomal diactins (HCL 432); **10**, hypodermal pentactin (HCL 432); **11**, choanosomal hexactin (HCL 432).

Spicules: Choanosomal skeleton of smooth diactins (fig. 15.8-9), 0.76-1.8/0.006-0.015 mm, with a widening in the central part. Choanosomal hexactins (fig. 15.10-11) smooth with rays 0.25-0.49/0.01 mm. Dermalia and atrialia pinular pentactins (fig. 15.1-2) of one or two kinds and pinular diactins. Small dermal pentactins have

Source : MNHN, Paris

pinular ray with apical cone and spines longest near the outer end or in the upper part. Pinular ray of small dermal pentactin 0.076-0.258/0.008 mm at base, 0.010 mm near the outer end; tangential rays 0.023-0.046/0.006-0.008 mm, covered with dense small spines. Large dermal pinular pentactins (fig. 15.5), with pinular ray spindle-like 0.167-0.517/0.016-0.018 mm. The longest spines are medially situated and the ray has an apical cone or is finely pointed. Tangential rays of large dermal pinular pentactins 0.030-0.122/0.008 mm, densely covered with short spines. Dermal pinular diactins (fig. 15.6-7) have the pinular ray similar to large pinular pentactins in shape and size (0.213-0.608/0.01-0.02 mm); the other ray (0.182-0.608/0.008-0.01 mm) is smooth or with rare spines near the outer end. These diactins have four rudimentary median tubercles and are similar to the large pentactins. Small atrial pentactins (fig. 15.3-4) have spindle-like pinular ray 0.084-0.228/0.01-0.015 mm and tangential rays 0.023-0.068/0.01 mm. Large atrial pentactins are similar to dermal ones, with pinular ray 0.137-0.532/0.016-0.018 mm and tangential rays 0.030-0.175/0.008 mm. Atrial pinular diactins with spindle-like pinular ray 0.205-0.836/0.01-0.02 mm, the other rays 0.137-0.851/0.008-0.01 mm. All these dermal and atrial spicules are present in specimens HCL 433 and in HCL 432. Only small pentactins were found in HCL 435, while pinular diactins were present in this specimen as in broken fragments. In other specimens the small dermal and atrial pentactins seem to be absent. Hypodermal and hypoatrial pentactins have smooth rays 0.3-0.5/0.01-0.03 mm.

Microstauractins (fig. 16.26-36) prevail to other spicules with similar rays from microhexactins to micromonactins. The stauractins often have a rudimentary fifth ray or a spine which lies in the central crest. In the specimen HCL 433 microstauractins usually have one pair of opposite rays longer than the other. Other specimens often have the stauractins with equal rays and more pentactins and hexactins. The 0.011-0.112/0.005 mm rays are densely covered with short spines.

The amphidiscs fall within three groups. Total length of macramphidiscs (fig. 16.1-19): 0.038-0.350 mm, umbel length 0.015-0.114 mm, umbel diameter 0.021-0.129 mm. The shaft of largest amphidiscs has a whorl of tubercles in the middle but sometimes these spicules have tubercles in other places. The smallest kinds of amphidiscs were found in HCL 433. They usually have smooth shafts, often represented by amphidiscs derivatives (fig. 16.12-18): paradiscs, hemidiscs, paradiscs without serrated or toothed discs, amphidiscs with additional rows of teeth, sometimes with teeth reduced in number, sometimes with teeth of different length. The umbel of macramphidiscs has 6, rarely 5, teeth which are oval in shape. Mesamphidiscs (fig. 16.20-23) have numerous teeth and elongate umbel, the teeth of opposite umbels may meet at the equator. The shafts of mesamphidiscs are densely covered with spines and have a whorl of spines and a widening in the middle. Total length of mesamphidiscs 0.040-0.153 mm, umbel length 0.013-0.072 mm, umbel diameter 0.011-0.054 mm. Micramphidiscs (fig. 16.24-25) have umbels nearly equal in length and diameter, shafts with spines in the middle and some spines in other parts of the shaft. Total length of micramphidiscs 0.011-0.050 mm, umbel length 0.004-0.016 mm, umbel diameter 0.004-0.020 mm. In HCL 433, HCL 432 and HCL 435 the largest mesamphidiscs can be larger than the smallest macramphidiscs, the same phenomenon is observed in mesamphidiscs and macramphidiscs in HCL 433, HCL 432 and HCL 431. In these cases amphidiscs are referred to one or another kind, according to their umbel proportion. In other specimens the different types of amphidiscs have no overlap in their length parameters and they are easily differentiated by their size.

REMARKS. — This new species can be easily distinguished from the many other species of the genus by the presence of microstauractins with rays of different length which predominate over other microhexactins derivatives. It is the only feature which unite all these very dissimilar specimens into one species. The greatest similarity is observed between HCL 432 and HCL 433 collected at the same station. The other group includes all other specimens. Maybe, these two groups should be divided into different subspecies. The presence of stauractins is reported for an another genus (or subgenus) of Hyalonematidae: *Chalaronema* (Ijima, 1927). *H. microstauractina* is tentatively placed into the subgenus *Oonema*, but this new sponge possesses some features of the other subgenera, *Paradisconema* and even *Cyliconema.* The main diagnostic feature of the doubtful subgenus *Paradisconema* is the mandatory presence of rare paradiscs among micramphidiscs (IJIMA, 1927), whereas in *H. microstauractina* paradiscs belong to the kind of smallest macramphidiscs and were found only in two out of six specimens. The outer ends of pinular pentactins in *H. microstauractina* are similar to those of both *Paradisconema* with the rachis of the ray of dermal pinular pentactin "thickest at base, and tapering towards tip" [see *H. (Paradisconema) vosmaeri*

Source : MNHN, Paris

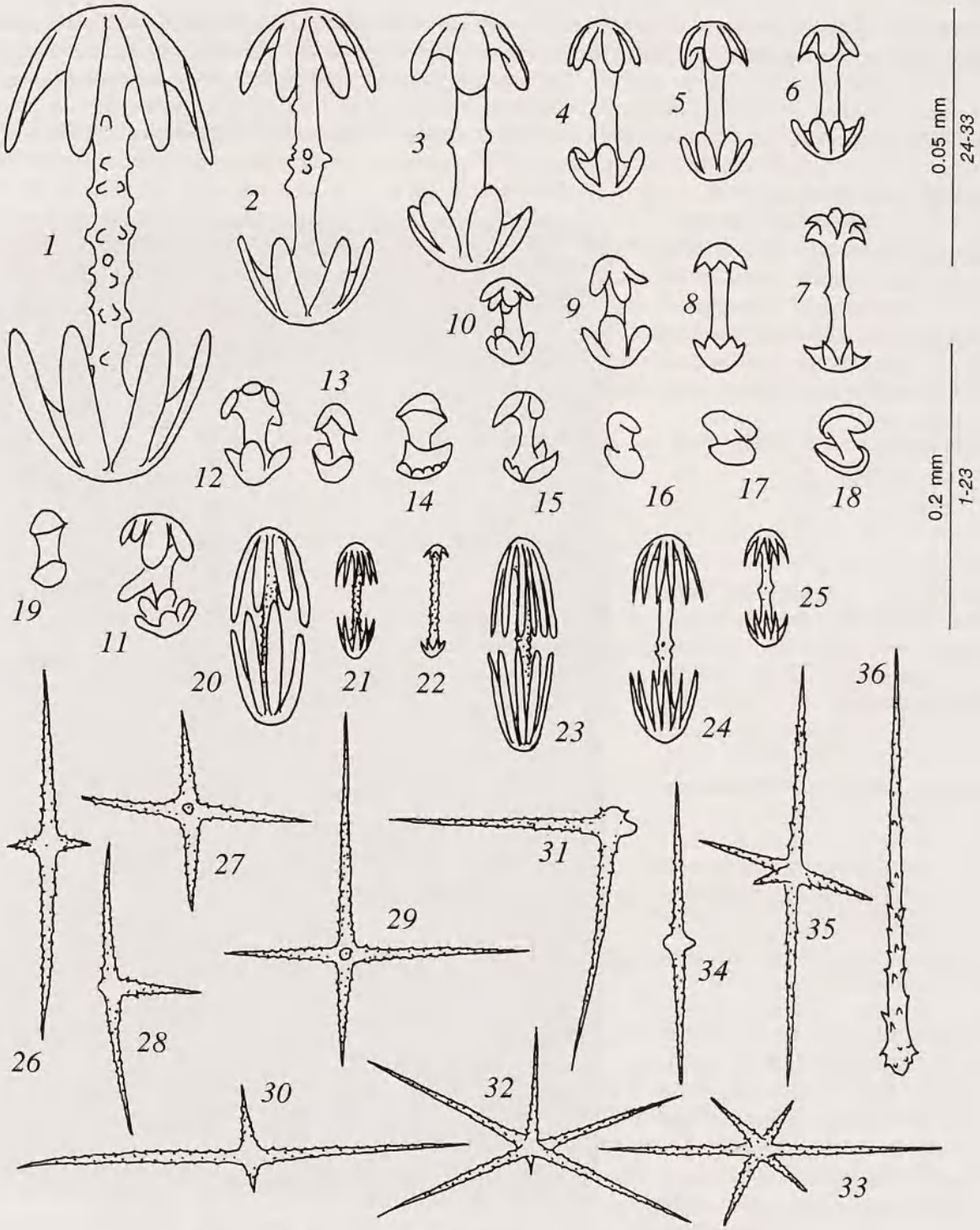

FIG. 16. — Spicules of *Hyalonema (Oonema) microstauractina* sp. nov.

1-19, macramphidiscs and derivatives: 1 (HCL 430); 2 (HCL 432); 3-19 (HCL 433).
12-18, paradiscs; **16**, **18**, paradiscs with unserrate and not-toothed umbels; **19**, macramphidisc with unserrate and not-toothed umbels.
20-23, mesamphidiscs: 20-21 (HCL 434); 22 (HCL 430); 23 (HCL 433).
24-25, micramphidiscs (HCL 433).
26-36, microstauractins and derivatives: 26, 30, 34, 36 (HCL 433) ; 32 (HCL 434); 33 (HCL 431).

Source : MNHN, Paris

with some rachis slightly swollen in the middle and an apical cone at the end (IJIMA, 1927)] and to *Oonema* with dermal pinular ray wearing the rachis "distinctly swollen in the middle parts or, toward the end, ending in an apical cone" (IJIMA, 1927). As in *Oonema* species, there are two kinds of small and large macramphidiscs, i.e. *H. sequoia, H. densum, H. crassipinulum, H. bianchoratum* (all LENDENFELD, 1915). In these species some of the small macramphidiscs are abnormal: with a tendency to develop paradiscs by having teeth of different length, by having curved and additional teeth, some macramphidiscs may be found with one rounded outer part of the umbel, and other being conically pointed. Such abnormal spicules are also known in *H. umbraculum* and *H. aequatoriale* (LENDENFELD, 1915), which were initially described as subgenus *Skianema* but that later turned to be junior synonyms of *Oonema* (Ijima, 1927). Two types of pinular pentactins are known in *H. (Oonema) bipinnulum* (LÉVI, 1964). Some specimens of *H. microstauractina*, which have the only type of dermal pinular pentactins, have no small macramphidiscs and hence the paradiscs are similar to the subgenus *Cyliconema*. The only notable difference is that the pentactin pinular rays of *Cyliconema* species have a finely pointed end which usually protrudes far beyond the last spines. Thus the new species presents the features that draw together, *Paradisconema, Oonema* and *Cyliconema* subgenera.

ETYMOLOGY. — The species name refers to the cruciform microholactin spicules.

Subgenus ***CYLICONEMA*** Ijima, 1927

DIAGNOSIS. — Dermal pinule ray short spiny and slender, in most cases under 0.250 mm length or longer and whip-like. Rachis thickest at base. Without ambuncinate. Microholactin hexactine.

Sponge more or less cup-like, without an oscular sieve plate or a gastral covering layer, so that the excurrent canals all open freely into the gastral cavity or on the gastral surface, which may be nearly externally exposed or even entirely everted.

Hyalonema (Cyliconema) pateriferum Wilson, 1904

Fig. 17

Hyalonema pateriferum Wilson, 1904: 28, pl. 1 fig. 1-13.
Hyalonema (Phialonema) pateriferum - VON LENDENFELD, 1915: 362, pl. 50 fig. 6-15, pl. 51 fig. 1-28, pl. 52 fig. 1-29.
Coscinonema pateriferum - LÉVI, 1964: 86, fig. 32.

MATERIAL EXAMINED. — **Loyalty Islands**. CALSUB, E. slope off Lifou Island, 20°35.4'S, 167°12'E, 2697 m, 23.02.1989: HCL 436.

DESCRIPTION. — This fine bright white saucer-shaped specimen is 90 mm long, 70 mm wide and 10 mm thick. The root-tuft reaches 330 mm long.

Its shape and structure are similar to the eastern Pacific sponges described by WILSON (1904) and VON LENDENFELD (1915). They are flat but one surface is slightly convex. It is very difficult to observe the excurrent orifices but the marginalia pinular diactins are found in the apical part of the sponge.

Spicules: The spiculation is quite similar to WILSON's specimens. Distal ray of gastral pentactins range 0.300-0.410 mm long; average width is 0.088 mm. Characteristic macramphidics 0.130-0.220 mm long; umbels 0.020-0.035 mm long and 0.060-0.070 mm broad. Teeth broad, 6 in number. Shaft with few central tubercules. Abundant mesamphidics 0.025 -0.066 mm long. Scarcely found microxyhexactins with rays, straight or sligthly bent. Acanthophora similar to the type present in the collar pad.

REMARKS. — VON LENDENFELD (1915) created the subgenus *Phialonema* for *Hyalonema pateriferum* Wilson and *Hyalonema brevancora* Lendenfeld. But IJIMA (1927) maintains only *H. brevancora* in *Phialonema* and assigned *H. pateriferum* to the subgenus *Coscinoderma*, used further by LÉVI (1964).

Source : MNHN, Paris

In fact, *Hyalonema pateriferum* does not have ambuncinates and the distal rays of pinular pentactins are short spiny and slender as in *Cyliconema*. If we do not keep *H. pateriferum* in the doubtful subgenus *Phialonema* defined by only one character, this species is referable to *Cyliconema*.

DISTRIBUTION. — Northern Peru 82-83°W - eastern tropical Pacific 104°-117°W; 3811-4063 m depth. Bottom temperature: 1.5-3°C.

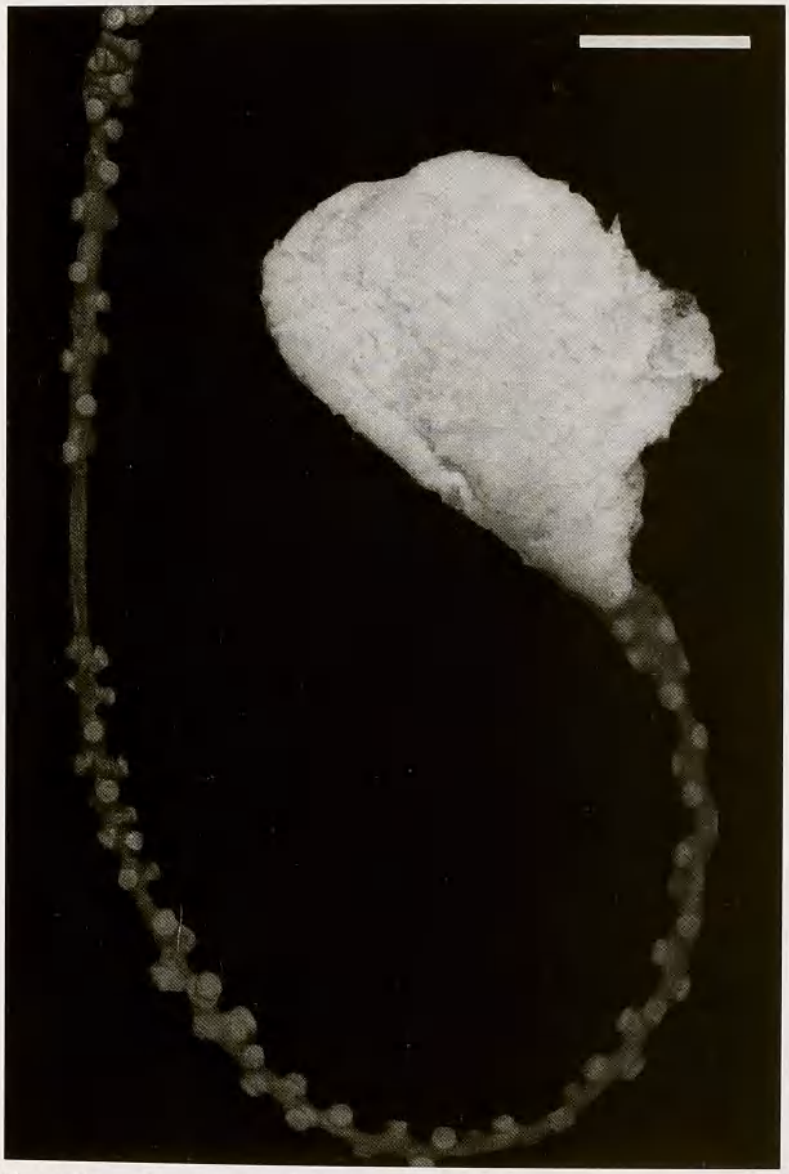

FIG. 17. — *Hyalonema (Cyliconema) pateriferum* Wilson, 1904 (HCL 436). Scale = 1 cm.

DISCUSSION. — One of the most outstanding features in the material examined is the presence of uncinates diactins, uncinates (or uncinates monactins) and spicules similar to ambuncinates in *H.(Onconema) uncinata*. According to IJIMA (1927) the family Hyalonematidae is characterized, besides other features, by the "absence of the uncinates" (p. 42) or "as a rule without uncinate" (p. 41). Instead of uncinates, which are common for the close family Pheronematidae, it is possible to find ambuncinates in the *Hyalonema* subgenera as in *Pteronema, Coscinonema* and *Euhyalonema* and uncinate diactins ("uncinate rhabdodiactins") in the subgenus *Onconema*. The poorly described *H. pellucidum* (Ijima, 1927, see footnote of p. 6) has some uncinates, called "ambuncinate diactin with all the spines bent in the same direction". Relatively rare uncinates of *H. agassizi* were especially discussed by IJIMA (1927). They have some vertically or even retroverted inclined spines near one end of a spicule. Such spicules are numerous and even prevail over the other types in *H. (Onconema) uncinata*. Some of these uncinates, the largest ones, have one smooth end and they are similar to some types of uncinates, which are present in the family Pheronematidae. The smaller type of uncinates are entirely covered with spines, and they are similar to those described for *H. (Onconema) agassizi* and especially discussed by IJIMA. The smaller type of uncinates have a widening in their central part and only the smallest ones have rudiments in shape of two tubercles. Does this morphological series of uncinates reflect their ontogenesis and phylogenesis? If it is a result of ontogenesis, the observed morphological differences represent development stages of the adult. If it is a result of recapitulation, the smallest type of uncinate is likely to be derived from the "archaic

Source : MNHN, Paris

stauractin" (IJIMA, 1927), and the largest type of uncinates which are described as uncinates monactins are uncinates diactins. Are the uncinates of Pheronematidae homologous to these large uncinates diactins? If so, the existence of uncinates monactins is questionable. Formally, according to morphology (asymmetry of spines) they are monactins, being however real diactins according to their origin. The only argument to their monactin nature is the absence of axial crest traces inside these spicules. Hence, we can conclude that it is very likely that the morphological series of uncinates observed in the subgenus *Onconema* displays some features of its phylogenesis and all the uncinates observed in other groups of Hexactinellida are likely to be uncinates diactins and only using the formal morphological criteria, it is possible to call them uncinates monactins. In the ontogenesis of *Farrea* the youngest uncinates show a widening in the middle (OKADA, 1928) and hence the uncinates of Hexasterophora may be also considered to be uncinates diactins according to their origin. Moreover, uncinates diactins were found together with usual uncinates (uncinates monactins) in mature *Tretocalyx polae* (Schulze, 1900). It is very likely that uncinates diactins, uncinates monactins and ambuncinates are close types of spicules, homologous not only in Hyalonematidae and Pheronematidae but even among Amphidiscophora and Hexasterophora. It is very difficult to come to a conclusion in favour of separate origin of uncinate-like spicules and some other smooth choanosomal spicules.

These facts point out the similarities of evolutionary trends even in quite separate branches of Hexactinellida, when similar but independently evolved structures give parallel series of variability.

Family MONORHAPHIDIDAE Ijima, 1927

Genus ***MONORHAPHIS*** Schulze, 1904

DIAGNOSIS (after IJIMA, 1927). — Amphidiscophora with uncinate, choanosomal supporting spicules predominantly tauactins, elongate in the complete axis and sometimes passing over into rhabdodiactin form by suppression of the unpaired ray; basalia a single, excessively strongly developed needle. Sponge body somewhat like a laterally compressed cylinder, with excurrent canals orifices, irregularly distributed on the surface, and showing on one body edge a longitudinal series of niche-like depressions covered with a sieve-like lattice.

Monorhaphis is one of the most peculiar genera of Hexactinellida. Among the specimens collected by the *"Valdivia"* in the Indian Ocean, SCHULZE (1904) identified two species, *M. chuni* and *M. dives*, based on the presence or absence of mesamphidiscs and abnormal micramphidiscs.

Since then, other specimens collected in Indonesia (IJIMA, 1927) and the Indian Ocean (BURTON, 1959) have been linked to these two species. We agree with SCHULZE (1886, 1893) and IJIMA (1927) that the very small fragment of "*Hyalonema* sp." collected off Luzon (Philippine Islands) renamed by SCHULZE as "*Hyalonema fruticosum*" belongs to *Monorhaphis*.

More recently, LI JINHE (1987) described *M. intermedia,* a new species from the China Sea. It has all types of spicules which exist in the two species described by SCHULZE.

Finally, *Monorhaphis* was observed during dives of the submarine *"Cyana"* in the Loyalty Basin (ROUX *et al.*, 1991a, 1991b). It was also found on the Norfolk Rise (LÉVI *et al.*, 1989) and on the outer slope of the Great Barrier Reef (HOOPER & WIEDENMAYER, 1994).

The MUSORSTOM and CIDARIS I cruises provided complete specimens and numerous raw basalia. The study of these collections allowed us to determine that *M. dives* and *M. intermedia* are junior synonyms of *M. chuni* Schulze, the type species of the genus (designation by DE LAUBENFELS, 1936).

Monorhaphis chuni Schulze, 1904

Fig. 18; Tab. 6-9

Monorhaphis chuni Schulze, 1904: 112, fig. 3-4, pl. 40-42, 44-48. — IJIMA, 1927: 37, fig. 3, pl. 6 fig. 11-12.

Source : MNHN, Paris

Monorhaphis dives Schulze, 1904: 121, pl. 43 fig. 1-20. — BURTON, 1959: 176.
Monorhaphis intermedia Li Jinhe, 1987: 130, pl. 1-2.

MATERIAL EXAMINED. — **Red Sea**. *"Anton Bruun"*: stn 7-370 D, 28°00'N, 35°60'E, 880 m: kt476 (USNM).
Somalia. *"Valdivia"*: stn 257, 1°48.2'N, 45°42.5'E, 1644 m: fragment of the holotype of *Monorhaphis dives* (NHM 1908.09.24.065). — Stn 264: 6°18.8'N, 49°32.5'E, 1079 m: fragment of *Monorhaphis chuni* (NHM 1908.09.24.064).
Madagascar (NW coast). *"Vitjaz II"*: stn 2601, 12°25.04'S, 48°08.00'E, 700 m: 5/2/1351, 5/2/1422, 5/2/1352 (IORAN). — Stn 2606, 12°26.70'S, 48°06.40'E, 700-720 m: 5/2/1408 (IORAN).
Australia (NE coast). CIDARIS I: stn 1-4, 18°08.69'S, 147°33.79'E, 962-966 m, 6.05.1986: p540 (MTQ). — Stn 4-1, 18°11.52'S, 147°52.12'E, 1012-998 m, 6.05.1986: fr767 (MTQ). — Stn 8-1, 18°07.82'S, 148°15.39'E, 1115-1119 m, 7.05.1986: fr867.1 (MTQ).
Chesterfield Islands. MUSORSTOM 5: stn CP 324, 21°15.01'S, 157°51.33'E, 970 m, 14.10.1986: HCL 408-409.
New Caledonia. BIOCAL: stn CP 61, 24°10.67'S, 167°33.65'E, 1070 m, 2.09.1985: HCL 445. — Stn CP 75, 22°20.42'S, 167°23.41'E, 825-860 m, 4.09.1985: HCL 405-407.
Loyalty Islands. CALSUB: stn 7, W of Lifou Island and N of Santal Bay, 20°48'S, 167°05'E, 970-489 m, 25.02.1989: HCL 411. — Stn 8, W of Lifou Island and N of Santal Bay, 20°48'S, 167°05'E, 880-516 m, 26.02.1989: HCL 412. — Stn 13, 21°26'S, 166°22.7'E, 1807-1567 m, 4.03.1989: HCL 410.

TYPES. — Those of *Monorhaphis chuni* are perhaps deposited at the Hamburg Museum.
A fragment of the holotype of *Monorhaphis dives* (*"Valdivia"*, stn 257: 1°48.2'N, 45°42.5'E, 1644 m) is deposited at The Natural History Museum, in London (NHM 1908.09.24.065).

DESCRIPTION. — Most of material examined consisted of fragments, but the typical shape of the genus may be often deduced. Only two sponges are complete specimens similar in shape to those described as *M. chuni* (Schulze, 1904) or observed and photographed from the submarine *"Cyana"* (ROUX *et al.*, 1991a, 1991b).

Spicules: Choanosomal spicules are chiefly tauactins (triactines, typical for the genus and family) with the opposite rays longer than the third one. These tauactins occur together with paratetractins and stauractins with two opposite rays notably longer than the other ones. Uncinates are also present in all specimens. Basalium, if present, is a single giant monaxonal diactine spicule.

Hypodermalia and hypoatrialia are represented by pentactins (fig. 18.1), with the ray directed inside the body longer than the tangential ones; the tangential rays are similar in length.

Dermalia and atrialia are pinular pentactins. They are very similar in shape and size to each other (see Tab. 6-9). The pinular ray of these pentactins is slightly widened toward the end, often with an apical cone which protrudes beyond the last spines. Canalaria are pinular pentactins observed in some, probably the biggest specimens. These pentactins are shorter than the dermal and atrial ones; the pinular ray is thicker at the base with an outer end finely pointed, the spines are notably shorter than the spines of dermal and atrial pentactins. All the spicules mentioned above are similar in all the examined specimens and in all the known descriptions (for references see synonymies). They can never be used for the species definition (see Tab. 9).

Microhexactins (fig. 18.3-5) (rarely micropentactins and microstauractins) are usually numerous in all the examined specimens. They are rare in kt476. The microhexactins have rays covered with more or less dense short spines.

The micramphidiscs (fig. 18.14-16) are more or less similar in all of these species. They are mostly similar in shape and size but in some specimens they may have more or less spinous shafts. Since curious micramphidiscs are rarely found among the normal ones it is possible to mention the following cases, but they seem to have no taxonomic significance. Micramphidiscs in the form of paradisc were observed in specimen kt417; the ratio of its umbels diameters is 0.7. Micramphidiscs with one tooth at each umbel (sigmoidal in shape) were found in NHM 5/2/1408, whereas in HCL 411 only two teeth were found at one side while at the other there was no umbel but a small spherical outer end instead. Micramphidisc in the form of tylodisc (fig. 18.18) with one umbel reduced to spherical end while the other is "normal" were found in NHM 1908.09.24.065. Micramphidisc (fig. 18.21) with one hemispherical umbel and the other conically pointed was found in HCL 410. And finally hexadiscs (fig. 18.13) corresponding to micramphidiscs in shape and size were found in fr767.

Source : MNHN, Paris

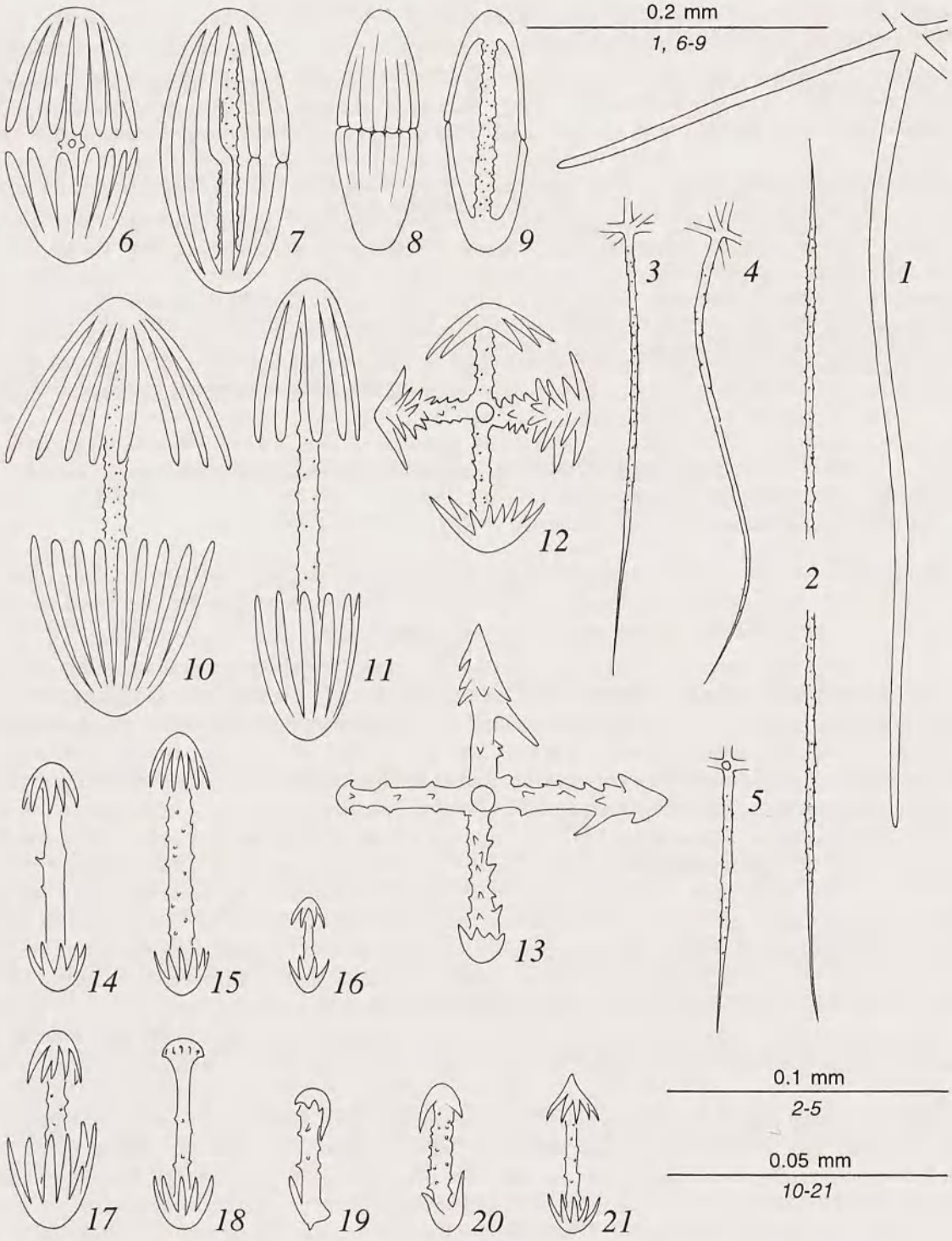

FIG. 18. — Spicules of *M. chuni* Schulze, 1904: **1**, hypodermal pentactin (5/2/1351); **2**, uncinate (5/2/1422); **3-4**, microhexactins (5/2/1351); **5**, microhexactins (fr867.1.); **6**, amphidisc intermediate between macramphidiscs and mesamphidiscs (fr867.1.); **7**, barrel-shaped mesamphidisc (HCL 409); **8-9**, mesamphidiscs with fused teeth (HCL 409) (9, optical section); **10-11**, amphidiscs intermediate between mesamphidiscs and micramphidiscs (10, HCL 411; 11, HCL 408); **12**, hexadiscs (HCL 411); **13**, hexadiscs (fr767); **14-15**, micramphidiscs (5/2/1351); **16**, abnormaly small micramphidisc (fr867.1); **17**, hemidisc (1908.09.24.064); **18**, tylodisc (1908.09.24.065); **19-20**, paradiscs (1908.09.24.064); **21**, micramphidisc with different umbels (HCL 410).

Source : MNHN, Paris

REMARKS. — Species of *Monorhaphis* were distinguished earlier by the presence or absence of macramphidiscs and mesamphidiscs. The macramphidiscs are usually notably larger (over 0.3 mm in length) than mesamphidiscs, and have fewer teeth (about 8) in each umbel; they often have smooth shafts or are provided with sparse short spines. Among macramphidiscs, forms with all or some of opposite teeth fused at equator (barrel-shaped, IJIMA, 1927) are present. All mentioned exceptions were found in all the observed materials. Mesamphidiscs are distinguished by their length, shafts densely covered with spines and often more elongate umbels than in micramphidiscs. Sometimes they can be found in the form of hexadiscs. Rarely mesamphidiscs (fig. 18.8-9) are found with fused opposite teeth as macramphidiscs: HCl 409, 406, 405. In one specimen, HCL 409, all the teeth of some mesamphidiscs were fused into a continuous silica layer. All the exceptions of mesamphidisc shapes are very similar to those of macramphidiscs. Moreover, forms of amphidiscs which are transitional between macramphidiscs and mesamphidiscs, and which could be hardly referred to as these kinds of spicules were widely observed in HCL 409, 406, 407. Kinds of amphidiscs transitional between micramphidiscs and macramphidiscs were observed in NHM 1908.09.24.065, HCL 408 and 410 as well.

The only known difference between three well described species of *Monorhaphis* — *M. chuni, M. dives* and *M. intermedia* — is the presence or absence of macramphidiscs and mesamphidiscs. Using this criterion, the existing material was arranged into six groups (Tab. 4). The first group consisted of *M. chuni* according to its original description (SCHULZE, 1904). The second group is *M. chuni* according to the description of IJIMA (1927). Unfortunately these sponges were not found in the investigated collections and the sponge NHM 1908.09.24.064 labeled as *M. chuni* turned out to be a suspected *M. dives.* The third group consisted of four specimens of *Monorhaphis* which were closer to *M. chuni* from its typical location, in shape and in spiculation except mesamphidiscs that are similar to *M. dives* (rare in 5/2/1408, and numerous in 5/2/1352). The fourth group included the investigated fragment of the holotype of *M. dives* (NHM 1908.09.24.065) and two sponges that could be doubtfully referred to this species by shape and by the fact that they were collected in nearby stations (NHM 1908.09.24.064 and kt476); and in NHM 1908.09.24.064 some macramphidiscs were found. The fifth group was *M. intermedia* according to the description of LI JINHE (1987). These include sponges that contain both macramphidiscs and mesamphidiscs together with their abnormal forms. The last and sixth group consisted of numerous specimens which are similar to *M. intermedia* collected off New Caledonia and Australia. It is possible to distinguish specimens without macramphidiscs (HCL 405, 410, 411, p540), specimens that contained neither macramphidiscs nor mesamphidiscs (HCL 412) and specimens that contained them both (all other specimens). It is obvious from this list that the diagnostic features distinguishing the species does not work and that the material showed all the possible variations. Concerning the length of microhexactin rays, the third group of *M. chuni* had rays about two times longer, but this type of spicule was poorly described in the holotype and such spicules of *M. chuni* described by IJIMA (1927) (second group) have the shortest rays of microhexactins comparable with those of most other specimens. Hence, the investigated and described species must be considered as synonyms of one polymorphic species, *M. chuni.*

Family PHERONEMATIDAE Gray, 1872

Genus ***SERICOLOPHUS*** Ijima, 1901

DIAGNOSIS (slightly emended after REISWIG & ZGRAGGEN, 1991). — Body shape like a thick tongue or spoon borne upon a compact root tuft of approximately equal length. Frontal and abfrontal surfaces respectively as gastral and dermal, with gastral surface strongly reflexed over the dermal surface around body margins. Gastral surface with open excurrent canals. Hexactins and pentactins as spicules principalia. With genuine uncinates. Pleuralia lateralia as monactine sceptres. Basalia include anchors and distinctive monactine "crook" spicules. Internally basalia radiate to body margins in several strands, without a columella or associated acanthophore.

TYPE SPECIES. — *Hyalonema reflexum* Ijima, 1894.

Source : MNHN, Paris

Sericolophus calsubus sp. nov.

Fig. 19-21; Tab. 10, 14

MATERIAL EXAMINED. — **New Caledonia**. BIOCAL: stn CP 75, 22°18.65'S, 167°23.30'E, 825-860 m, 4.09.1985: HCL 446.
CALSUB: stn 8, 20°48.3'S, 167°05'E, 880-516 m, 26.02.1989: HCL 155.

TYPES. — *Holotype*: HCL 155 (CALSUB, stn 8, 20°48.3'S, 167°05'E, 880-516 m).
Paratype: HCL 446 (BIOCAL, stn CP 75, 22°18.65'S, 167°23.30'E, 825-860 m).

DESCRIPTION. — The shape and structure of the body are typically those of the genus *Sericolophus*. The holotype is a well preserved sponge 100 mm in long, 70 mm wide and 12 mm thick; a long single tuft of basalia is about 100 mm long. The paratype is a poor fragment.

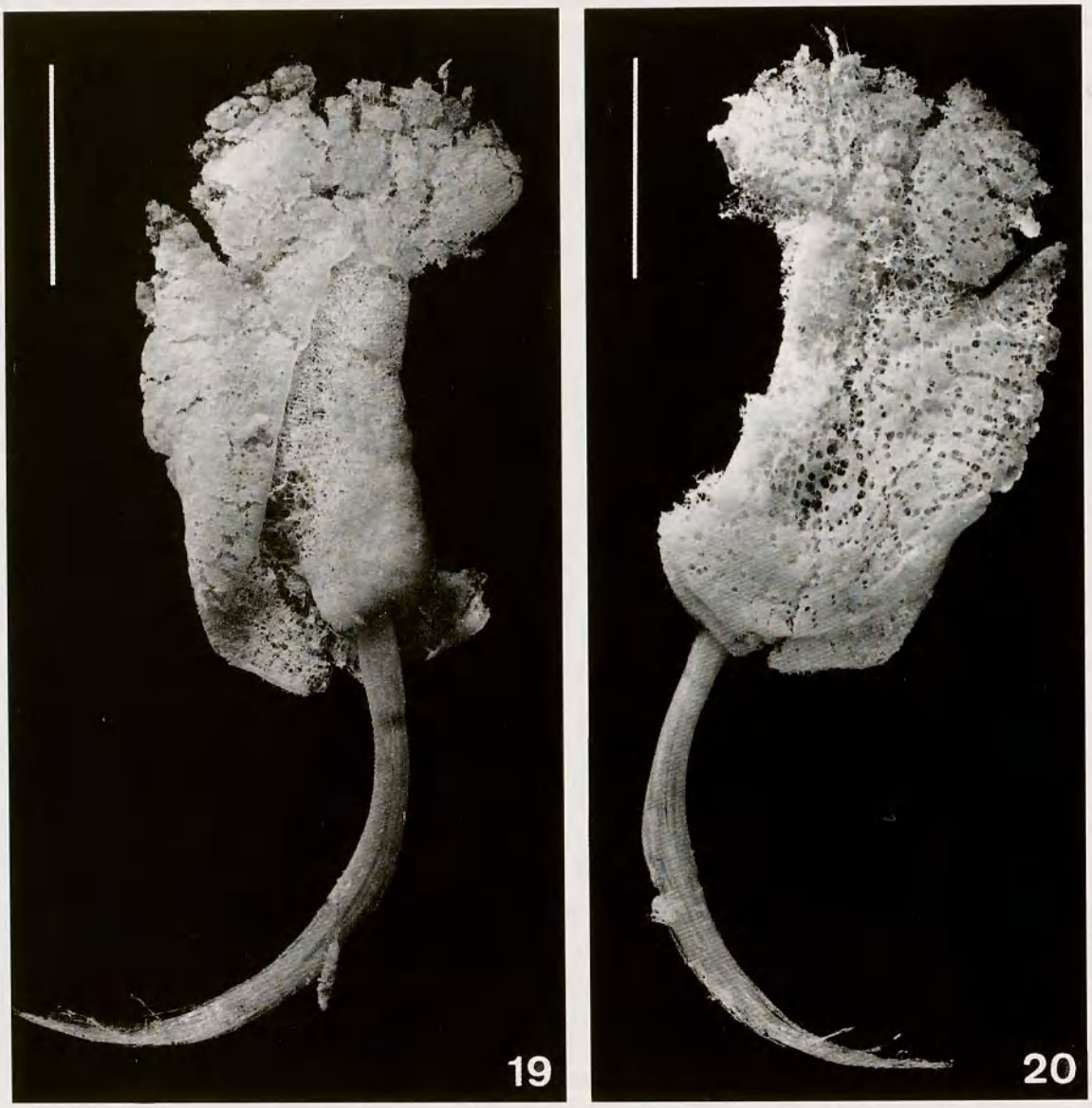

FIG. 19-20. — *Sericolophus calsubus* sp. nov. (HCL 155). Scales = 4 cm.

Source : MNHN, Paris

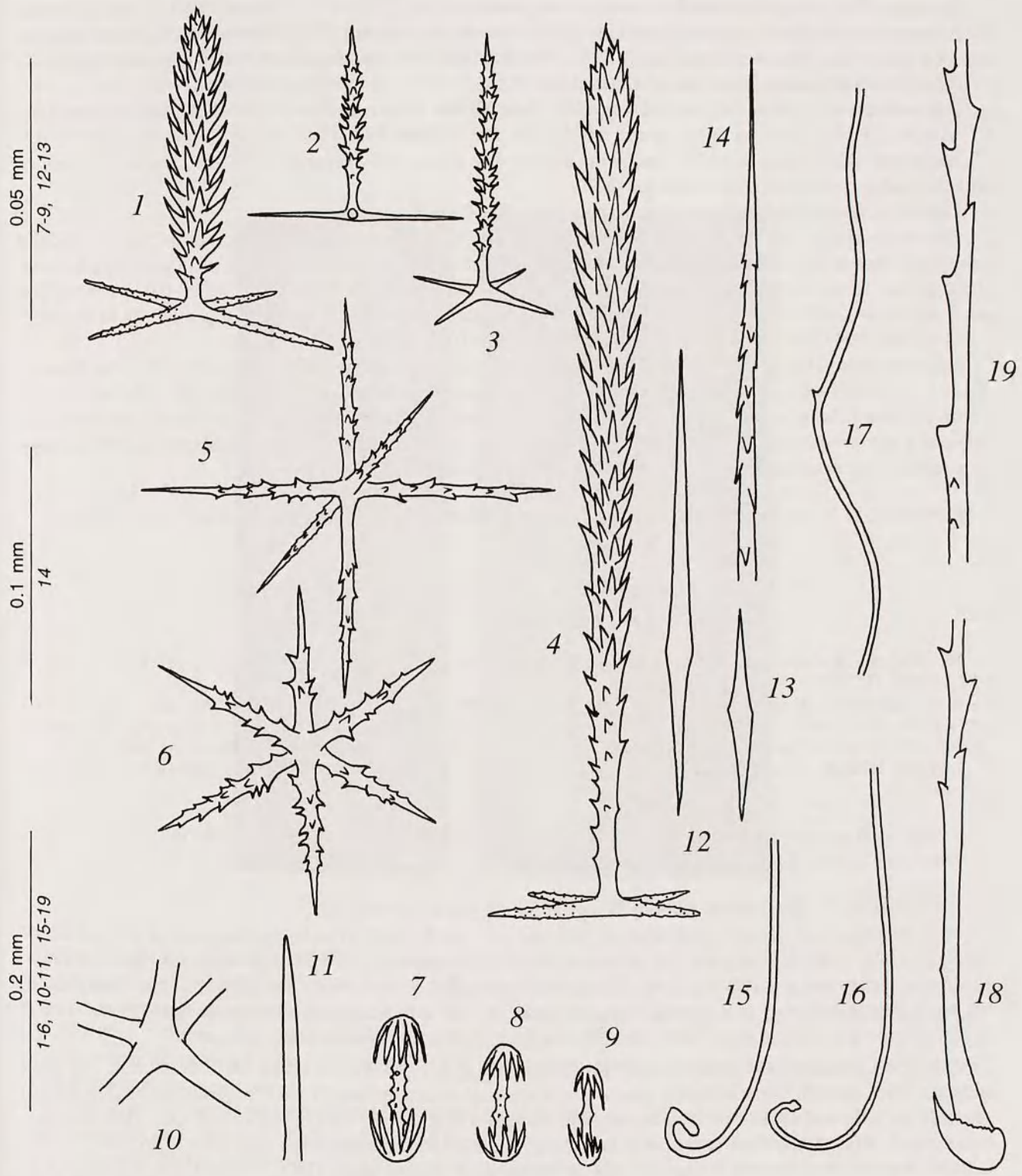

FIG. 21. — Spicules of *Sericolophus calsubus* sp. nov. (HCL 155): **1-2**, dermal pinular pentactins; **3-4**, atrial pinular pentactins; **5-6**, microhexactins; **7-9**, micramphidiscs; **10**, choanosomal pentactin; **11**, outer end of choanosomal pentactin; **12-13**, micruncinates; **14**, macruncinate; **15-16**, crooks; **17**, shaft of crook; **18**, anchorate basalia; **19**, shaft anchorate basalia.

Source : MNHN, Paris

Spicules: The choanosomal skeleton consists of pentactins (fig. 21.10-11) with rays 0.7-1.3/0.02-0.03 mm. Uncinates are of two types. Macruncinates (fig. 21.14) several mm long and about 0.005 mm in diameter, they are covered with spines. Micruncinates (fig. 21.12-13) 0.032-0.108/0.004 mm, smooth or with some sparse spines.

Basalia are anchorate spicules, crooks and diactins.

Diactins are straight, smooth spicules not less than 27 mm long and about 0.015-0.038 mm in diameter. Crooks (fig. 21.15-17) several mm long and 0.005-0.008 mm in diameter.

Anchorate basalia (fig. 21.18-19) rare in the microscopic slides. Only several one-toothed anchorate spicules with the shaft covered with spines were found.

Dermalia canalaria and atrialia are pinular pentactins (fig. 21.1-4).

Pinular ray slightly widened toward the outer end. It is sharply pointed. Upper end free, projecting beyond the last spines. Spines present at a short distance from the base. Some pinular rays of both dermalia and atrialia have short spines. Tangential rays are smooth. Pinular ray of dermal pentactin 0.099-0.361/0.007-0.019 mm, of the atrial one 0.144-0.608/0.007-0.022 mm. Tangential rays usually covered with spines. Tangential ray of dermalia 0.034-0.114/0.004-0.006 mm, of the atrial one 0.046-0.087/0.004-0.011 mm.

Microhexactins (fig. 21.5-6) covered with spines, they have rays 0.068-0.175/0.007-0.011 mm. Amphidiscs (fig. 21.7,9) are of only one type that corresponds to micramphidiscs of other Pheronematidae. Total amphidiscs 0.018-0.056 mm long, umbel length 0.007-0.018 mm, umbel diameter 0.006-0.014 mm, shafts covered with spines and rare widenings. The amphidiscs have usual shape, except some cases of asymmetry of umbels similar to paradiscs. One macramphidisc, probably of foreign origin, was found in the paratype.

ETYMOLOGY. — The species name refers to the name of the cruise, CALSUB, during which it was collected.

Sericolophus neocaledonicus sp. nov.

Fig. 22-25; Tab. 11, 14

MATERIAL EXAMINED. — **Chesterfield Islands**. MUSORSTOM 5: stn CP 323, 21°18.52'S, 157°18.62'E, 970 m, 14.10.1986: HCL 173-175.

New Caledonia. BIOCAL: stn CP 34, 23°12.44'S, 167°11.87'E, 710-700 m, 29.08.1985: HCL 157-161. — Stn CP 54, 23°10.08'S, 167°43.54'E, 1000-950 m, 1.09.1985: HCL 162, 447-451. — Stn CP 60, 23°58.87'S, 167°07.72'E, 1530-1480 m, 2.09.1985: HCL 452. — Stn CP 75, 22°40.42'S, 167°23.41'E, 825-860 m: HCL 163-164.

Loyalty Islands. BIOGEOCAL: stn CP 297, 20°38.64'S, 167°10.77'E, 1230-1240 m, 28.04.1987: HCL 156, 165-172.

TYPES. — *Holotype*: HCL 425 (BIOCAL, stn CP 60, 23°58,87'S, 167°07,72'E, 1530-1480 m).

Paratypes: all the other specimens mentioned above.

DESCRIPTION. — The form of the body is typical for the genus *Sericolophus*.

Most specimens are lamellar fragments of different parts of the body. The largest fragment is the one of the holotype HCL 452 (BIOCAL, stn CP 60) now broken in fragments. Alive, it was very soft and similar to *S. reflexus* Ijima, and it is 190 mm long, 90 mm in diameter and 15 mm thick. The slightly convex and smooth surface is gastral, with very fine meshes of pinular pentactins. On each side, the reflexed parts of the gastral surface is 25-30 mm wide. The paratype HCL 156 is 80 mm long, 30 mm in diameter and 7 mm thick.

Spicules: Choanosomal spicules usually pentactins (fig. 24.8-11) with rays about 5/0.02-0.05 mm. The outer ends are often smooth but sometimes rough. Three types of uncinates were found. Macruncinates (fig. 24.14) several mm long and 0.015 mm in diameter. Mesuncinates (fig. 24.13) 0.135-0.426/0.004 mm. Both macruncinates and mesuncinates are covered with spines. Spindle-like micruncinates (fig. 24.12, 25.8-10) 0.041-0.137/0.004 mm smooth with a single widening. Some small mesuncinates (HCL 174) could have features of both types, they have spines and widenings. Sceptres (fig. 24.15) rare, they are several mm long and 0.009 mm in diameter. Prostalia basalia crooks (fig. 24.16-18) about 0.006 mm in diameter, long diactins 0.03-0.06 mm in diameter and anchorate spicules (fig. 24.19-20). The anchorate spicules are rare. The only complete anchor has no

Source : MNHN, Paris

tooth, it has the shape of a clavule with serrated pileate end, the rachis 0.010-0.015 mm. Dermal and atrial spicules pinular pentactins (fig. 24.1-2) similar in shape. Pinular ray slightly widened medially; the outer end is sharply pointed and freely projects not far from the last spines. The spines appear on a short distance from the base. Pinular ray of dermal pentactines 0.065-0.342/0.007-0.015 mm, of atrial ones 0.076-1.079/0.015-0.019 mm. Tangential rays covered with short spines. Tangential ray of dermal pentactins 0.030-0.137/0.006 mm, of atrial ones 0.011-0.175/0.007 mm.

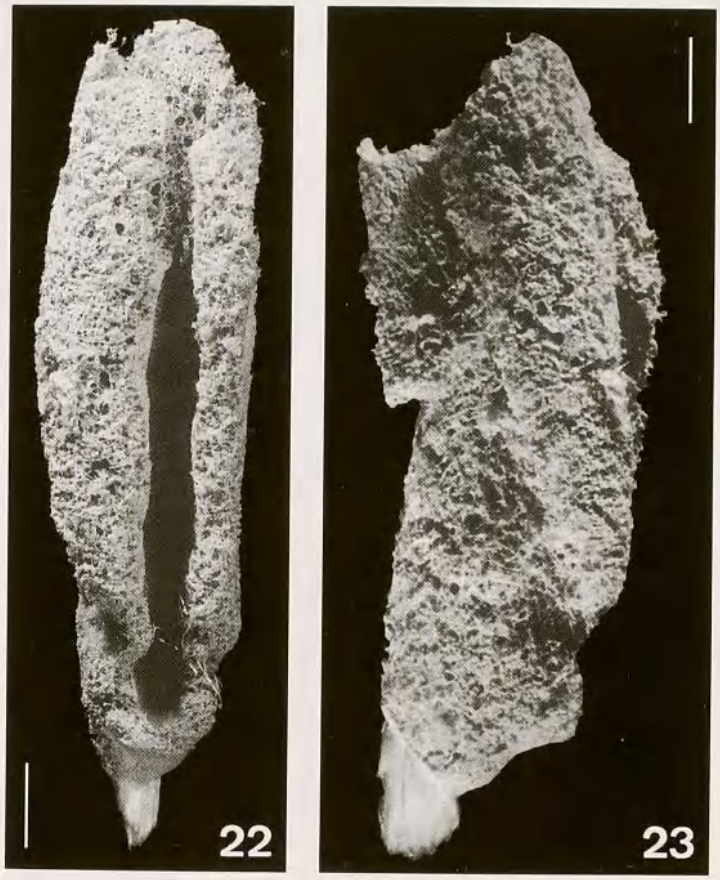

FIG. 22-23. — *Sericolophus neocaledonicus* sp. nov. (HCL 425). Scales = 1 cm.

Microhexactins (fig. 24.3-5, 25.1-7) are more numerous than other forms: pentactins, stauractins, monactins and polyactins spicules with more than six rays. Their rays are usually covered with spines, rarely smooth with sparse spines or entirely smooth. The microhexactins are usually represented by two types: with thick rays 0.046-0.205/0.015-0.030 mm and with thin rays 0.046-0.213/0.004-0.007 mm. The proportion of the two types of microhexactins varies in different specimens. The thick-rayed forms usually predominate but in HCL 175 and 160 the proportion is the opposite.

The amphidiscs (fig. 24.6-7) are represented by two types: mesamphidiscs and micramphidiscs. They both have shafts covered with spines. Total length of mesamphidiscs 0.032-0.122 mm, umbel length 0.011-0.044 mm, umbel diameter 0.010-0.035 mm. Total length of micramphidiscs 0.015-0.050 mm, umbel length 0.005-0.020 mm, umbel diameter 0.004-0.018 mm.

ETYMOLOGY. — This specific name refers to the recorded locality.

Source : MNHN, Paris

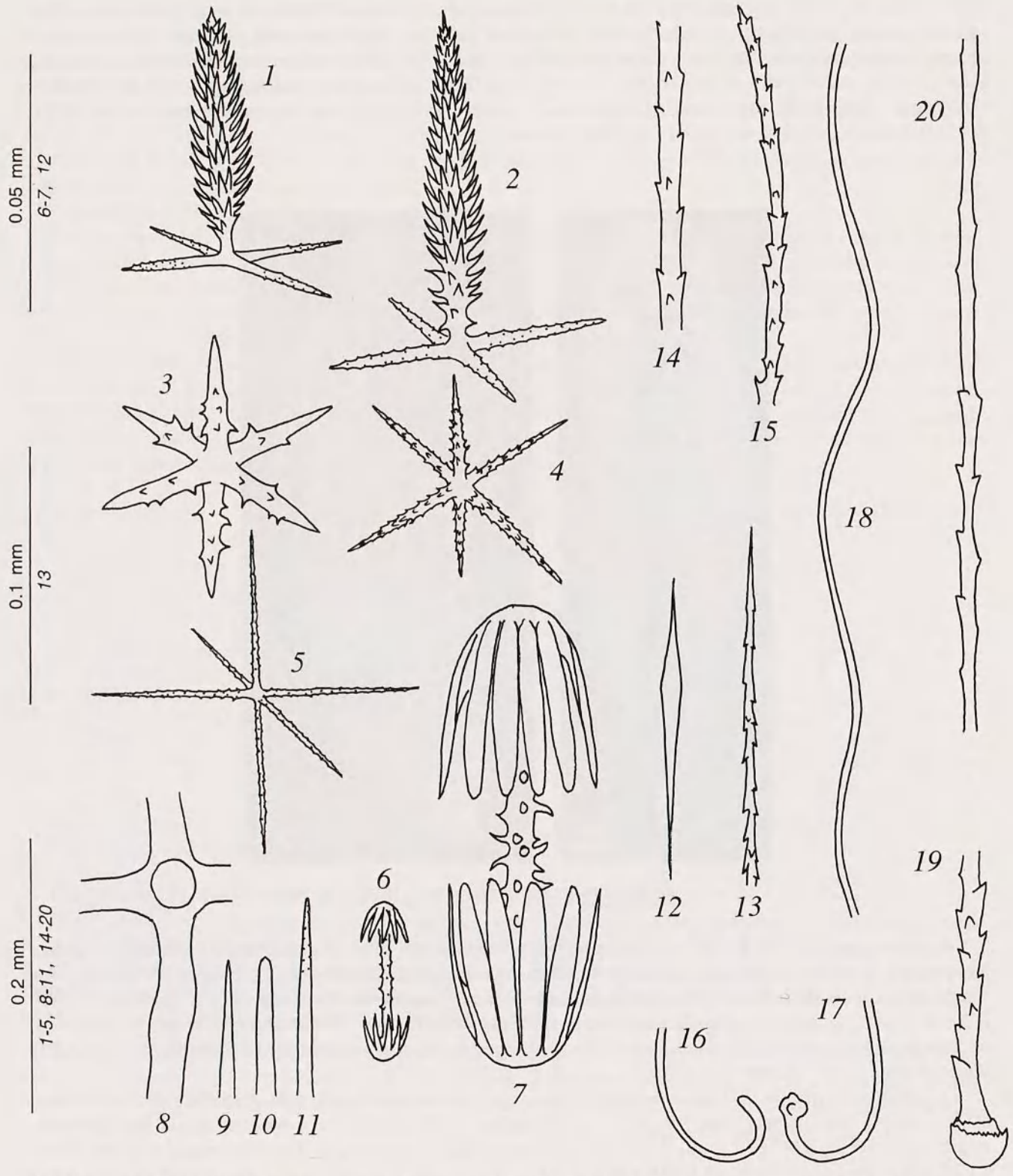

FIG. 24. — Spicules of *Sericolophus neocaledonicus* sp. nov. (HCL 156): **1**, dermal pinular pentactin; **2**, atrial pinular pentactin; **3-5**, microhexactins; **6**, micramphidisc; **7**, mesamphidisc; **8**, choanosomal pentactin; **9-11**, outer ends of choanosomal pentactin; **12**, micruncinate; **13**, mesuncinate; **14**, macruncinate; **15**, sceptre; **16-17**, crooks; **18**, shaft of crook; **19**, anchorate basalia; **20**, shaft of anchorate basalia.

Source : MNHN, Paris

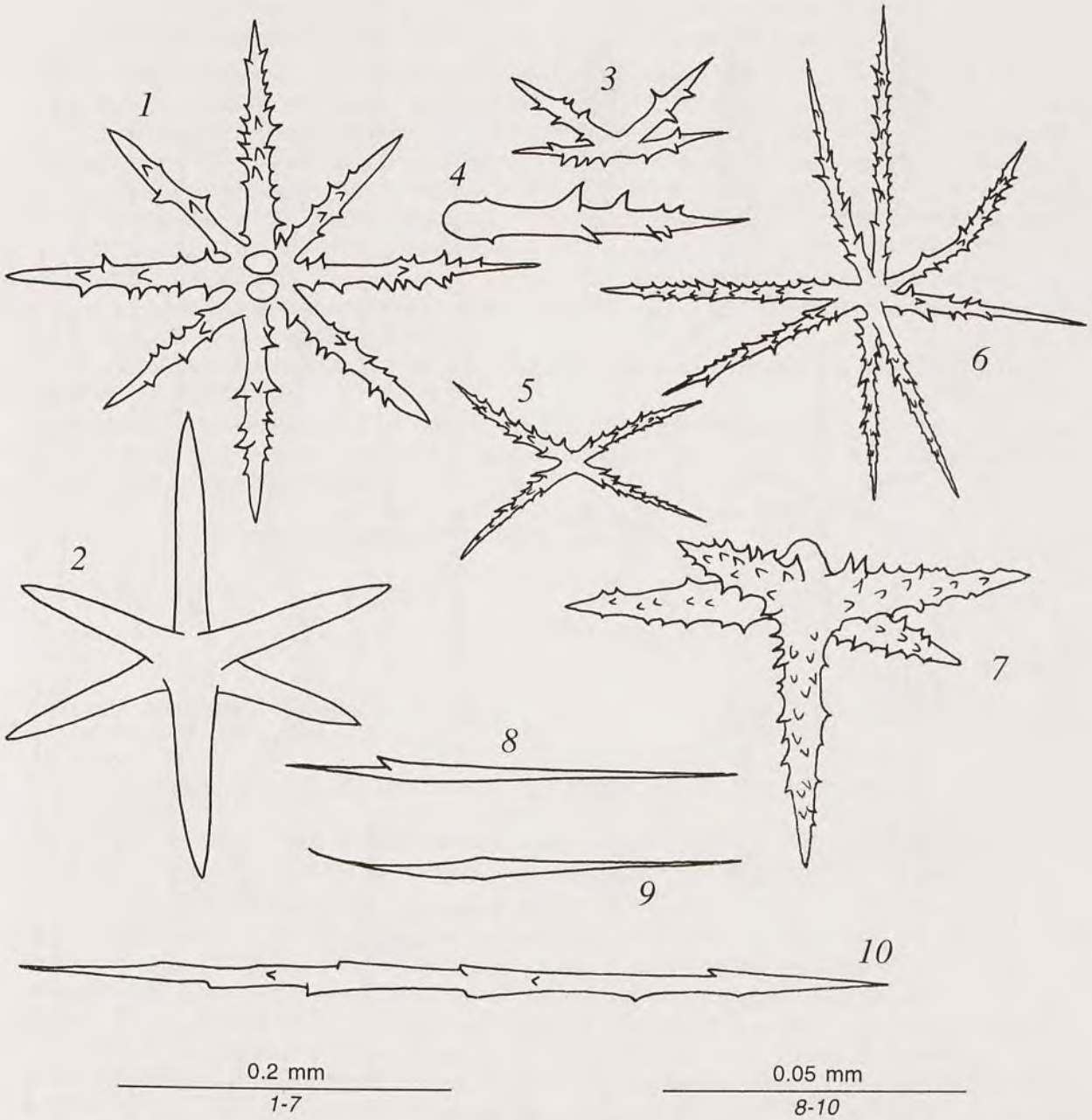

FIG. 25. — Spicules of *Sericolophus neocaledonicus* sp. nov.: **1-7**, deformed microhexactins; **8-10**, micruncinates [1 (HCL 175), 2 (HCL 167), 3-4 (HCL 162), 5 (HCL 162), 6 (HCL 173), 7-9 (HCL 167), 10 (HCL 174)].

Sericolophus hawaiicus sp. nov.

Fig. 26; Tab. 12, 14

MATERIAL EXAMINED. — **Hawaii**. HURL-88: stn P5-057, 19°37'N, 156°02'W, 580 m: co471 (BPBM). HURL-92, stn 5201, 20°53'N, 157°38'W, 380 m: co475 (BPBM).

TYPES. — *Holotype*: co475 (HURL-92, sta. 5201, 20°53'N, 157°38'W, 380 m).
Paratype: co471 (HURL-88: stn P5-057, 19°37'N, 156°02'W, 580 m).

Source : MNHN, Paris

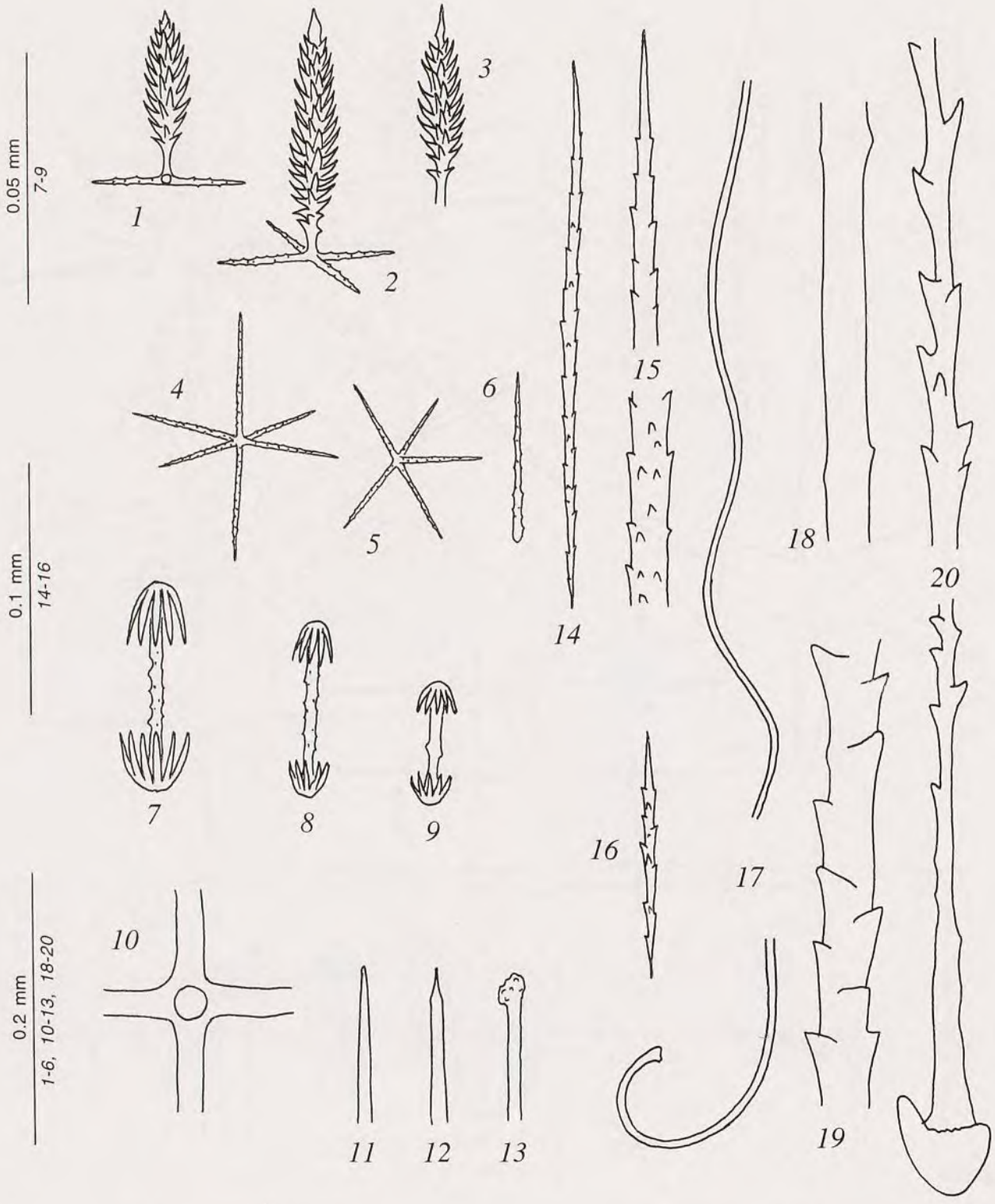

FIG. 26. — Spicules of *Sericolophus hawaiicus* sp. nov.: **1**, dermal pinular pentactin (co475); **2**, atrial pinular pentactin (co475); **3**, pinular ray of atrial pinular pentactin (co475); **4**, microhexactin (co475); **5**, micropentactin (co475); **6**, micromonactin (co475); **7-9**, amphidiscs (co475); **10**, choanosomal pentactin (co475); **11-13**, outer ends of choanosomal pentactin (co475); **14, 16**, micruncinates (co475); **15**, macruncinate (co475); **17**, crook (co471); **18-20**, shafts of basal anchorate spicule (co471).

Source : MNHN, Paris

DESCRIPTION. — The holotype is a fragment 12 mm in diameter of the lower part of the sponge with a tuft of basalia about 200 mm long and 17 mm in diameter. The paratype is a small fragment.

Spicules: The choanosomal spicules are pentactins (fig. 26.10-13) with rays, 0.24-1.37/0.008-0.016 mm. Uncinates are represented by two types. Macruncinates (fig. 26.15) are several mm in length and about 0.008-0.016 mm in diameter. The micruncinates (fig. 26.14-16) (according to the spicule size in other species) or mesuncinates (according to their shape) are about 0.1-0.5/0.004 mm. All uncinates are covered with spines. Basalia consists of crooks (fig. 26.17) and anchorate spicules. A single, one-toothed, anchorate spicule (fig. 26.18-20) was found. It is not clear which side of the fragment is dermal and which is atrial, but spicules (fig. 26.1-2) of both sides are similar in shape and size. The pinular rays (0.068-0.182/0.004-0.011 mm) are sharply pointed. The upper end of the pinular ray is usually long but sometimes relatively short. The outer ends of pinular rays are always sharply pointed and project beyond the ends of last spines. The tangential rays (0.038-0.072/0.004 mm) are covered with spines or smooth.

Microhexactins (fig. 26.4-6) covered with spines predominate over micropentactins and micromonactins. Their rays are 0.063-0.117/0.007 mm.

The only type of amphidiscs (fig. 26.7-9) corresponds to micramphidiscs of other species. The shafts of micramphidiscs are covered with spines. Total length of micramphidisc 0.020-0.065 mm, umbel length 0.005-0.021 mm, umbel diameter 0.005-0.019 mm.

ETYMOLOGY. — This specific name refers to the recorded locality.

Sericolophus cidaricus sp. nov.

Fig. 27; Tab. 13-14

MATERIAL EXAMINED. — **Australia**. *Northeastern coast*. CIDARIS I: stn 4.1, 18°11.52'S, 147°52.12'E, 1012-998 m, 6.05.1986: HCL 180 (MTQ).

TYPES. — *Holotype*: HCL 180 (CIDARIS I, stn 4.1, 18°11.52'S, 147°52.12'E, 1012-998 m).

DESCRIPTION. — The holotype is a fragment of a nearly complete specimen, 200 x 110 x 20 mm, with a tuft of basalia. The sponge is damaged but the body shape, typical for the genus *Sericolophus,* is recognizable.

Spicules: The choanosomal spicules are usually pentactins (fig. 27.8-10), rarely their derivatives such as tauactins. Their rays are 0.008-0.023 mm in diameter. The uncinates are represented by two types. The macruncinates (fig. 27.12) are long, 0.003-0.016 mm in diameter. They are covered with spines. The micruncinates (fig. 27.13-14), 0.061-0.120/0.011-0.015 mm, are smooth (smallest ones) or partly serrated (larger ones), they both have widening. The spicules of basalia are represented by crooks (fig. 27.11) (0.004 mm in diameter) only. The dermal and atrial spicules are pinular pentactins (fig. 27.1-3) similar in shape. The pinular ray is constant in thickness, sharply pointed and projects freely beyond the last spines. The spines begin at a short distance from the base. The pinular ray of dermal pentactins is 0.217-0.813/0.004-0.022 mm, of atrial ones 0.186-1.904/0.015-0.019 mm. The tangential rays of dermal pentactins are pointed and covered with short spines. The tangential rays of atrialia are covered with spines longer and denser than those of the dermalia; they are pointed or rounded. The tangential ray of dermal pentactins is 0.038-0.129/0.004-0.013 mm, of atrial ones 0.057-0.148/0.013 mm.

Microhexactins (fig. 27.4) predominate over other types of analogues spicules (fig. 27.5-7): micropentactins, microstauractins, micromonactins and polyactins. All these spicules are covered with spines. Their rays are 0.076-0.107/0.007-0.009 mm. Two types of amphidiscs can be observed. Mesamphidiscs (fig. 27.16) have shafts with spines or tubercles. Total length of mesamphidisc 0.058-0.104 mm, umbel length 0.013-0.032 mm, umbel diameter 0.018-0.030 mm. Micramphidiscs have shafts with spines or widenings. Total length of micramphidiscs 0.016-0.040 mm, umbel length 0.005-0.013 mm, umbel diameter 0.005-0.014 mm. Some macramphidiscs (fig. 27.15) 0.312/0.099/0.122 mm with tuberculated shafts are not certain to belong to this species.

Source : MNHN, Paris

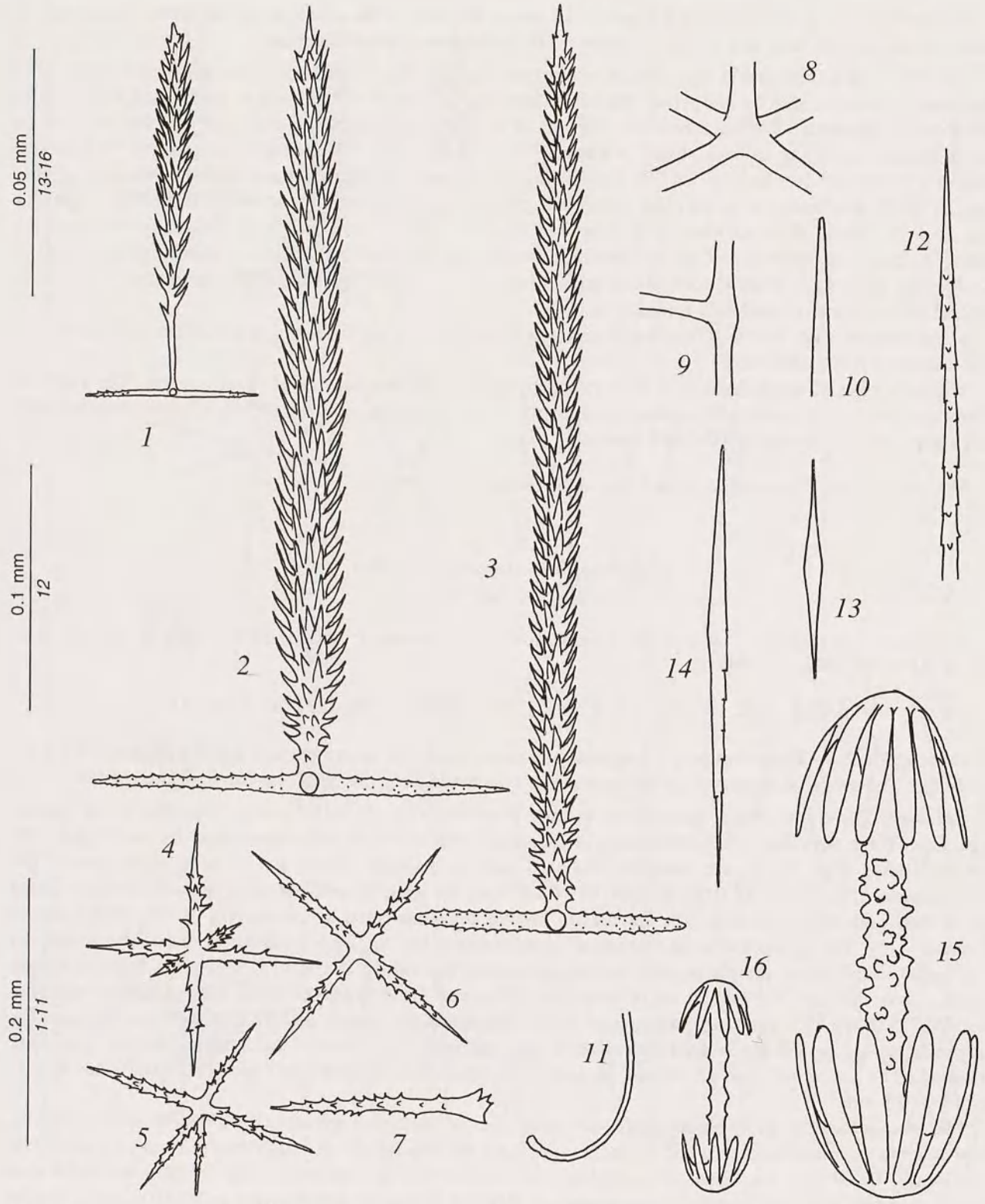

FIG. 27. — Spicules of *Sericolophus cidaricus* sp. nov. (HCL 180): **1-2**, dermal pinular pentactin; **3**, atrial pinular pentactin; **4**, microhexactin; **5**, micropentactin; **6**, microstauractin; **7**, micromonactin; **8**, choanosomal pentactin; **9**, choanosomal tauactin; **10**, outer end of choanosomal spicule; **11**, crook; **12**, macruncinate; **13-14**, micruncinates; **15**, macramphidisc; **16**, mesamphidisc.

Source : MNHN, Paris

REMARKS. — All specimens of *Sericolophus* described earlier (for references see REISWIG & ZGRAGGEN, 1991) were collected off Japan. All belong to *S. reflexus*. The best descriptions of the Japanese materials were made by IJIMA and OKADA (1938). REISWIG & ZGRAGGEN (1991) completed the previous descriptions and clarified the problem of synonymies. The specimens from Hawaii, New Caledonia and Australia obviously belong to the same genus. Their shape is similar to that of *S. reflexus* and they have crooks that are never found in representatives of other genera. Species of *Sericolophus* are distinguished by a combination of size classes of amphidiscs, shapes and size variations of microhexactins, dermal and atrial pinular pentactins and uncinates (Tab. 14). These features are distributed mosaically among these species. *S. neocaledonicus* and *S. cidaricus* are similar in size of amphidiscs and variations of microhexactins (up to monactins). They differ in the proportions of dermal and atrial pinular pentactins and the presence of thick-rayed microhexactins in *S. neocaledonicus*. *S. calsubus* has microamphidiscs smaller than those of *S. neocaledonicus* and *S. cidaricus*. Dermal and atrial pinular pentactins of *S. calsubus* differ in size. The maximal diameter of the microhexactins of *S. calsubus* is intermediate between those of the two other species. *S. hawaiicus* differs from the others by more significant features: small-sized dermal and atrial pentactins, and short and thin-rayed microhexactins and micruncinates bearing spines similar to macruncinates. The anchorate spicules of basalia of *S. reflexus* are best known. The anchors in *S. reflexus* have one, sometimes two, teeth with serrations on the anchorate margin. Numerous accessory spines, even similar to teeth, seem to be secondary elements as a result of "developed serration" (REISWIG & ZGRAGGEN, 1991). A unique but predictable form was found in *S. neocaledonicus* with pileate head and serrated margin, devoid of teeth. It may be considered as a derivate of the "normal" toothed anchors. This spicule is analogous in shape to some clavules of *Farrea* (IJIMA, 1927). These features of basalia have low taxonomic value and after careful investigation of other materials, the difference among basalia may disappear.

ETYMOLOGY. — The species is named after the CIDARIS cruise along the N.E. Australian slope.

Genus ***SEMPERELLA*** Gray, 1868

DIAGNOSIS (after IJIMA, 1927). — Pheronematidae of a columnar or a club-like body shape, without gastral concavity, consisting internally of alternating incurrent and excurrent systems of anastomosing canals, which stand in relation respectively with several dermal and oscular areas distinguishable in all parts of the external surface. Dermal areas covered with uniformly fine-meshed lattice; oscular areas either covered with a larger-meshed lattice or opening through relatively large orifices, found isolated or in close groups. Basalia arising in separate tufts, join in a matted mass.

TYPE SPECIES. — *Hyalonema schultzei* Semper, 1868.

Semperella schultzei (Semper, 1868)

Fig. 28

Hyalonema schultzei, Semper, 1868: 272.
Semperella schultzei - J.E. GRAY, 1868: 373. — W. MARSHALL, 1875: 212, fig. 67-83, pl. 12 fig. E, pl. 16-17. — W. MARSHALL & MEYER, 1877: 276, fig. 18-19, pl. 14, pl. 15. — SCHULZE, 1886: 67; 1887: 261, pl. 51-52. — BLACKBURN, 1896: 57, pl. 1. — OKADA, 1932: 16. — IJIMA & OKADA, 1938: 441, pl. 15 fig. 1-3, pl. 16 fig. 22-32. — LÉVI & LÉVI, 1982: 289, fig. 3-4, pl. 4 fig. 2, pl. 5; 1989: 29, fig. 1.

MATERIAL EXAMINED. — **Chesterfield Islands**. MUSORSTOM 5: stn DC 378, 19°53.74'S, 158°38.30'E, 355 m, 20.10.1986: HCL 186.
New Caledonia. Dragages *"Vauban"*: stn 39, 22°29'S, 166°23'E, 375-550 m, 5-7.06.1979: HCL 201.
MUSORSTOM 4: stn CC 175, 18°59.30'S, 163°17.50'E, 370 m, 17.09.1985: HCL 183-185. — Stn CC 202, 18°58.00'S, 163°10.50'E, 580 m, 20.09.1985: HCL 182. — Stn CC 241, 22°09.00'S, 167°12.20'E, 470-480 m, 3.10.1985: HCL 453.

Source : MNHN, Paris

BIOCAL: stn CP 42, 22°46.09'S, 167°13.80'E, 380 m, 30.08.1985: HCL 181. — Stn DW 44, 22°47.35'S, 167°14.50'E, 440-450 m, 30.08.1985: HCL 188.

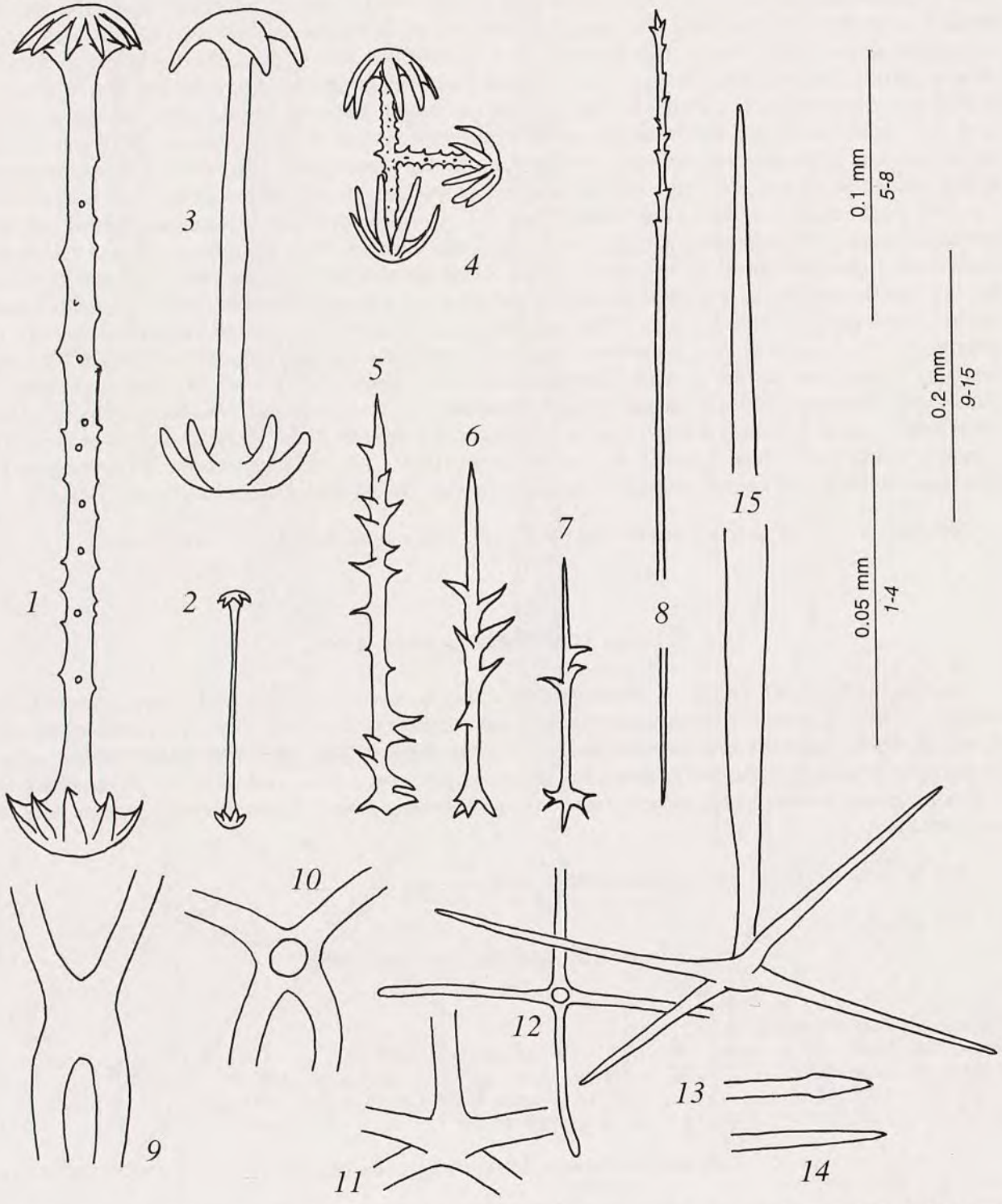

FIG. 28. — Spicules of *Semperella schultzei* (Semper, 1868): **1-4**, curious amphidiscs (1-3, HCL 198; 4, HCL 182); **5-7**, micromonactins (5-6, HCL 200; 7, HCL 182); **8**, sceptre (HCL 186); **9**, choanosomal stauractin; **10-12**, choanosomal pentactins; **13-14**, outer ends of choanosomal spicules; **15**, choanosomal hypodermal or hypoatrial pentactin.

Source : MNHN, Paris

Loyalty Islands. MUSORSTOM 6: stn DW 391, 20°47.35'S, 167°05.70'E, 390 m, 13.02.1989: HCL 197. — Stn DW 393, 20°48.29'S, 167°09.54'E, 420 m, 13.02.1989: HCL 198. — Stn DW 410, 20°38.05'S, 167°06.65'E, 490 m, 15.02.1989: HCL 190. — Stn DW 412, 20°40.60'S, 167°03.75'E, 15.02.1989: HCL 195. — Stn CP 415, 20°40.20'S, 167°03.95'E, 461 m, 15.02.1989: HCL 196. — Stn DW 428, 20°23.54'S, 166°12.57'E, 420 m, 17.02.1989: HCL 189. — Stn DW 448, 20°55.66'S, 167°22.34'E, 410 m, 19.02.1989: HCL 191-194.

Wallis and Futuna Islands. MUSORSTOM 7: stn DW 510, 14°14.50'S, 178°11.50'W, 280-370 m, 12.05.1992: HCL 199. — Stn DW 605, 13°21.3'S, 176°08.3'W, 335-340 m, 26.05.1992: HCL 200.

DISTRIBUTION. — *S. schultzei* is widely distributed from New Caledonia and the southwestern Pacific to Japan. Nearly all the specimens show similar morphological features except some from the Australian region which may be considered as a new subspecies (unpublished data).

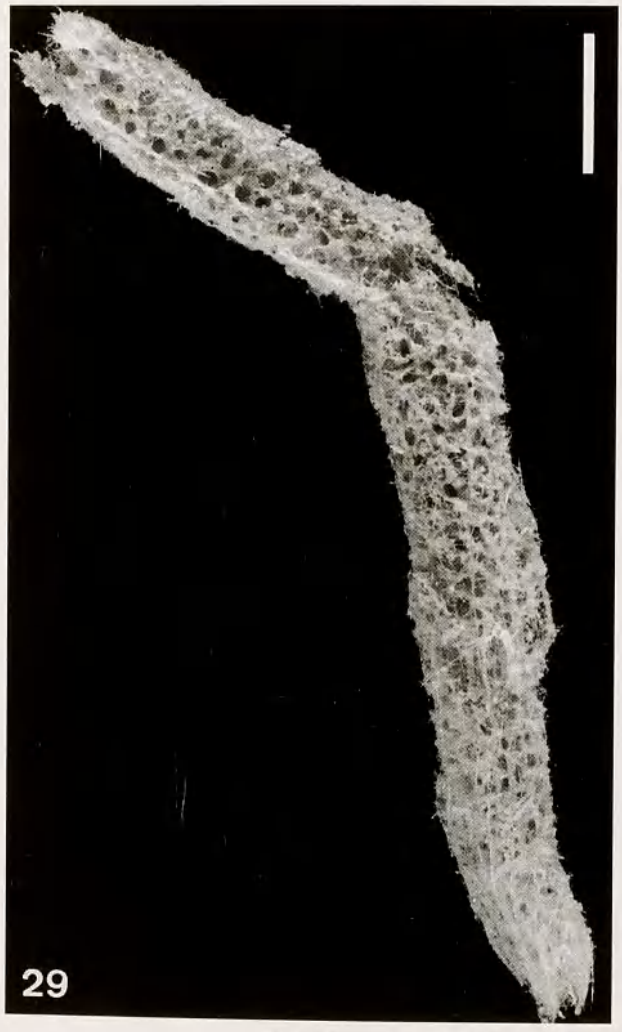

FIG. 29. — *Semperella varioactina* sp. nov. (HCL 202). Scale = 1 cm.
FIG. 30. — *Semperella abyssalis* sp. nov. (HCL 203). Scale = 3 cm.

Semperella varioactina sp. nov.

Fig. 29, 31; Tab. 15

MATERIAL EXAMINED. — **New Caledonia**. BIOCAL: stn CP 61, 24°10.67'S, 167°33.65'E, 1070 m, 2.09.1985: HCL 202.

Source : MNHN, Paris

TYPES. — *Holotype*: HCL 202 (BIOCAL: stn CP 61, 24°10.67'S, 167°33.65'E, 1070 m).

DESCRIPTION. — The general shape is elongated, columnar, sligthly broader in the middle. The holotype is 140 mm long, 8-12 mm in diameter.

The body presents a rectangular cross-section and the general surface of the sponge is divided into four longitudinal areas without sieve plates. In all specimens or fragments, oscular and dermal areas cannot be recognized. Openings of transverse canals (1-1,5 mm in diameter), are scattered.

Spicules: The choanosomal skeleton consists of pentactins (fig. 31.4-9) and rare stauractins with rays 0.3-4.6/0.008-0.180 mm. The rays are smooth, rarely with rough outer ends. Uncinates (fig. 31.10) are rare, and only fragments about 0.004 mm in diameter were found. Basalia and other prostalia were not found. Dermalia and atrialia are pinular pentactins (fig. 31.1-3). The atrial pinular pentactins were not found with certainty. The pinular ray 0.099-0.198/0.007 mm is sharply pointed, the upper end projects freely beyond the ends of last spines. The spines are relatively short, being bent upward; they begin at a short distance from the base. The tangential rays (0.061-0.137/0.007 mm) are curved and acutely intersect in pairs, as in other *Semperella* species. Tangential rays mainly smooth. Outer ends or even more than half of a ray covered with short spines directed upward.

Microhexactins (fig. 31.11-22) and their derivatives, including monactins and spheres (pearls), are rough or spinous. Some spicules have enclosing unequal angles. Stauractins, monactins and pentactins are numerous. Ray length of these spicules is 0.061-0.137/0.007 mm. The monactins have one spherical, the other finely pointed outer ends. Only one type of amphidisc (fig. 31.23-25) is present, but their length varies greatly. The shafts of these amphidiscs are covered with short spines. Total length of amphidiscs 0.032-0.108 mm, umbel length 0.009-0.038 mm, umbel diameter 0.007-0.032 mm.

ETYMOLOGY. — The species is named after the diversity of microholactine spicules.

Semperella abyssalis sp. nov.

Fig. 30, 32; Tab. 16

MATERIAL EXAMINED. — **Loyalty Islands**. BIOGEOCAL: stn CP 306, 20°35.18'S, 167°13.99'E, 2960-3036 m, 1.05.1987: HCL 203-208.

TYPES. — *Holotype*: HCL 203 (BIOGEOCAL, stn CP 306, 20°35.18'S, 167°13.99'E, 2960-3036 m).
Paratypes: HCL 205-208.

DESCRIPTION. — The sponge is subcylindrical. The holotype is over 210 mm long and 35 x 25 mm in maximal section. The paratypes are over 100-170 mm long, and are flatter than the holotype (15 x 10 - 25 x 5 mm). They were probably squeezed. No basalia were found in these specimens. The atrial surface is band-like, and situated along the dermal surface. In the holotype two such bands merge in the upper part of the sponge.

Spicules: The choanosomal skeleton consists of pentactins (fig. 32.7-11) and rare stauractins with smooth rays 0.2-13/0.02-0.09 mm, equal or unequal in length. Uncinates (fig. 32.12) 0.002-0.004 mm in diameter are rarely found. Basalia and prostalia marginalia are absent. Dermal and atrial spicules are very similar; most are pinular pentactins (fig. 32.1-6) or hexactins. The dermal pentactins of the holotype have pinular ray 0.129-0.296/0.007-0.030 mm (avg. 0.183 mm, std. 0.047 long), tangential ray 0.061-0.167/0.005-0.007 mm (avg. 0.092 mm, std. 0.026 long). The atrial pentactins of the holotype have similar parameters; the pinular ray is 0.122-0.303/0.007-0.030 mm (avg. 0.177 mm, std. 0.036 long), the tangential ray 0.053-0.211/0.005-0.007 mm (avg. 0.103 mm, std. 0.035 long). Two types of spicules with different pinular outer ends are present among dermal and atrial pentactins. The first has the pinular ray widening toward the outer end with conical tip which do not project freely beyond the ends of the last spines. The long spines bent upward and the longest ones are often situated at the upper part of the ray. The second has pinular ray widening slightly toward the end and covered with short spines. The conical upper end freely projects beyond the ends of last spines. The spines appear close to the base of the shaft. The tangential rays are curved and smooth, with outer ends covered with short spines directed upward.

Source : MNHN, Paris

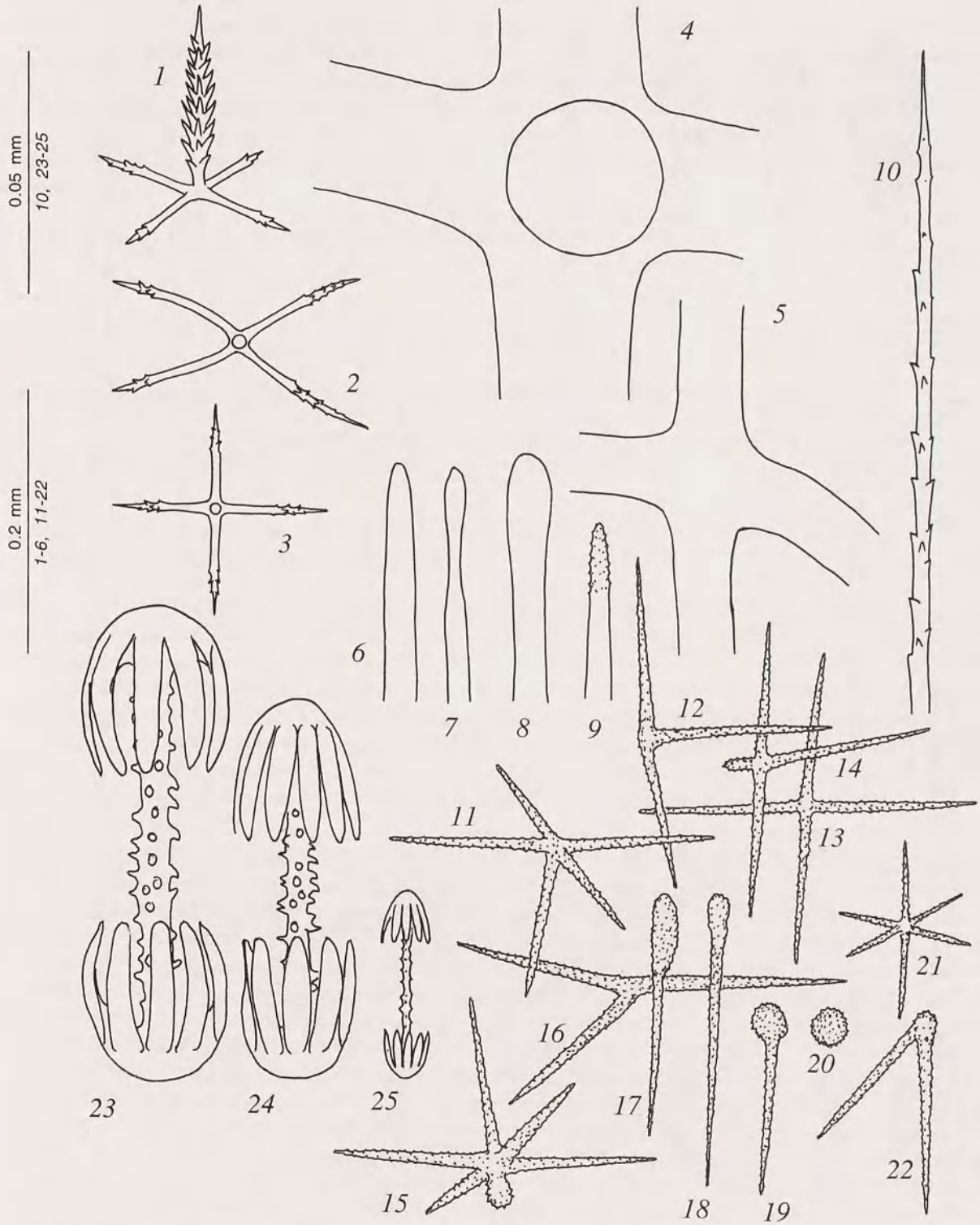

FIG. 31. — *Semperella varioactina* sp. nov. (HCL 202): **1**, dermal pinular pentactin; **2-3**, tangential rays of dermal pinular pentactin; **4**, choanosomal pentactin; **5**, choanosomal stauractin; **6-9**, outer ends of choanosomal spicules; **10**, uncinate; **11**, micropentactin; **12, 16** microtauactins; **13**, microstauractin; **14**, microtauactin with rudimental ray; **15**, micropentactin with rudimental ray; **17-19**, micromonactin; **20**, microsphere; **21**, microhexactin; **22**, microdiactin; **23-24**, macramphidiscs; **25**, micramphidisc.

Source : MNHN, Paris

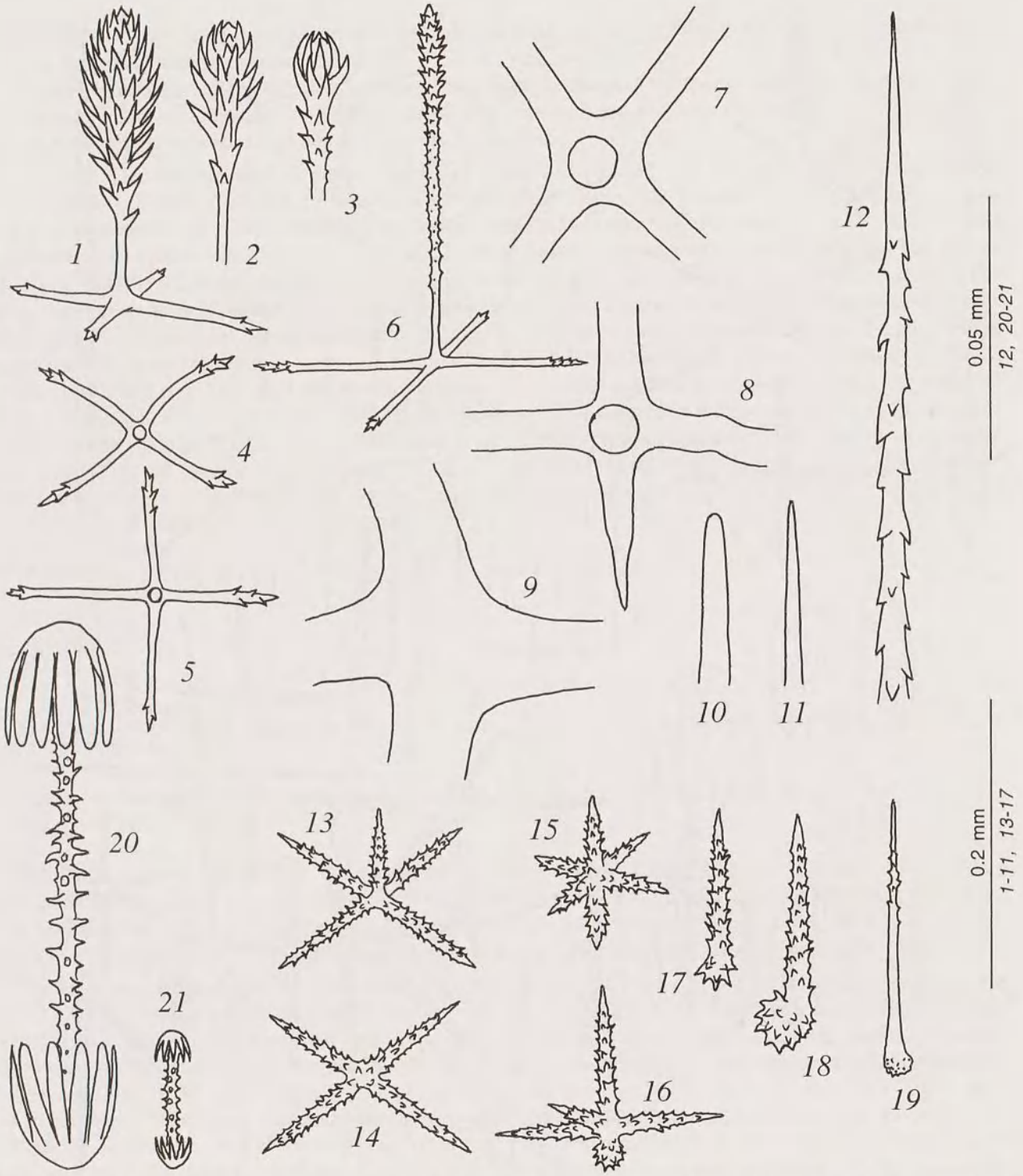

FIG. 32. — *Semperella abyssalis* sp. nov.: **1**, **6**, atrial pinular pentactins (HCL 203); **2-3**, pinular rays of atrial pentactins (HCL 203); **4-5**, tangential rays of atrial pentactins (HCL 203); **7-8**, choanosomal pentactins (HCL 203); **9**, choanosomal stauractin (HCL 203); **10-11**, outer ends of choanosomal spicules (HCL 203); **12**, uncinate (HCL 203); **13**, micropentactin (HCL 203); **14**, microstauractin (HCL 203); **15**, microhexactin (HCL 206); **16**, microtauactin with rudimental ray (HCL 205); **17**, micromonactin (HCL 203); **18**, micromonactin (HCL 205); **19**, micromonactin (HCL 204); **20**, macramphidisc (HCL 203); **21**, micramphidisc (HCL 203).

Source : MNHN, Paris

Micropentactins (fig. 32.13) have rays (0.046-0.167/0.009-0.011 mm) entirely covered with short spines. Micropentactins coexist with rare other spicules (fig. 32.14-19): microhexactins, microstauractins, microtauactins and micromonactins. A micromonactin has spherical, finely pointed outer end. The micromonactins are partly or entirely covered with spines as well as other spicules mentioned above. The size of amphidiscs (fig. 32.20-21) varies widely, but probably belongs to one type. The largest are about 5 times longer than the smallest. The shafts of these amphidiscs are covered with short spines. In the smallest amphidiscs the shaft may be slightly curved and the umbels slightly asymmetrical. Total length 0.016-0.119 mm, umbel length 0.004-0.036 mm, umbel diameter 0.005-0.025 mm.

ETYMOLOGY. — This species name refers to its deep-sea habitat.

Semperella crosnieri sp. nov.

Fig. 33-37; Tab. 17-18

MATERIAL EXAMINED. — **New Caledonia**. BIOCAL: no other data: HCL 210.
Loyalty Islands. BIOGEOCAL: stn CP 297, 20°38.64'S, 167°10.77'E, 1230-1240 m, 28.04.1987: HCL 212.
CALSUB: stn 6, W of Lifou Island and N of Santal Bay, 20°48'S, 167°02.4'E, 1150-400 m, 24.02.1989: HCL 211.
Combes Bank *(near Wallis and Futuna Islands)*. MUSORSTOM 7: stn CP 550, 12°14.8'S, 177°28.0'W, 800-810 m, 18.05.1992: HCL 209.

TYPES. — *Holotype*: HCL 209 (MUSORSTOM 7, stn CP 550, 12°14.8'S, 177°28.0'W, 800-810 m).
Paratypes: all the others specimens mentioned above.

DESCRIPTION. — The sponge is cylindrical, ovoid or flattened in section. The holotype is a tongue-like sponge over 240 mm long and about 160 x 40 mm in section. It has three short rows of prostalia in the upper part. The paratypes are cylindrical, over 280 and 330 mm in length and about 100-180 mm in diameter. The paratype HCL 211 is a complete specimen 330 mm long and 70 mm in diameter, with small rows of pleuralia on the upper end (some scattered pleuralia are located on the lateral side). Surfaces occupied by the atrialia are irregularly located. They probably correspond to the areas of the surface covered with large-meshed latticework, whereas dermalia - areas of the surface are covered with small-meshed latticework. The small meshed area (dermal area) is located on both sides, on one side together with occasionally situated areas of large-meshed surfaces (atrial area).

Spicules: The choanosomal skeleton consists of pentactins (fig. 37.11-15) and rare stauractins with smooth rays 0.1-4.6/0.008-0.26 mm. Their rays are often bent in an X-form. The uncinates (fig. 37.17-18) include two types. Macruncinates are long and about 0.002-0.01 mm in diameter. Micruncinates are shorter and thinner and 0.002 mm in diameter. The macruncinates were rarely found in preparations of the holotype's spicules, the micruncinates are rare in the paratype HCL 211. Basalia (fig. 37.19) are present in the paratype HCL 211 only. They are anchor-like two-toothed spicules covered with spines. Prostalia are sceptres (fig. 37.16) as usual for other Pheronematidae. Dermal and atrial spicules are pinular pentactins (fig. 37.1-4), similar in shape. The pinular ray is sharply pointed and bears short spines appearing close to the base. The pinular ray of dermal pentactins is 0.072-0.300/0.004-0.006 mm, the pinular ray of atrial pentactin is 0.076-0.342/0.004-0.006 mm. The tangential rays are curved and smooth, with outer ends covered with short spines. The tangential ray of dermal pentactin is 0.038-0.103/0.004-0.006 mm, the tangential ray of the atrial pentactin is 0.038-0.133/0.004-0.006 mm.

Micropentactins (fig. 37.5-10) and rare microhexactins have rays 0.031-0.171/0.011-0.022 mm usually thick and entirely covered with numerous or rarely sparse spines. These spines are long, and are directed toward the base of the ray. The amphidiscs (fig. 37.20) are nearly uniform in shape and size. Total length 0.014-0.029 mm, the umbel length 0.005-0.009 mm, the umbel diameter 0.005-0.011 mm. The shafts of these amphidiscs are covered with short spines.

REMARKS. — It is often difficult to decide if a specimen belongs to *Semperella* or to *Poliopogon*. Typical specimens of *Semperella* have columnar body shape whereas *Poliopogon* are plate-like, with dermal and atrial surfaces on the opposite sides. The atrial surface of *Semperella* is not continuous, and it shows numerous areas

Source : MNHN, Paris

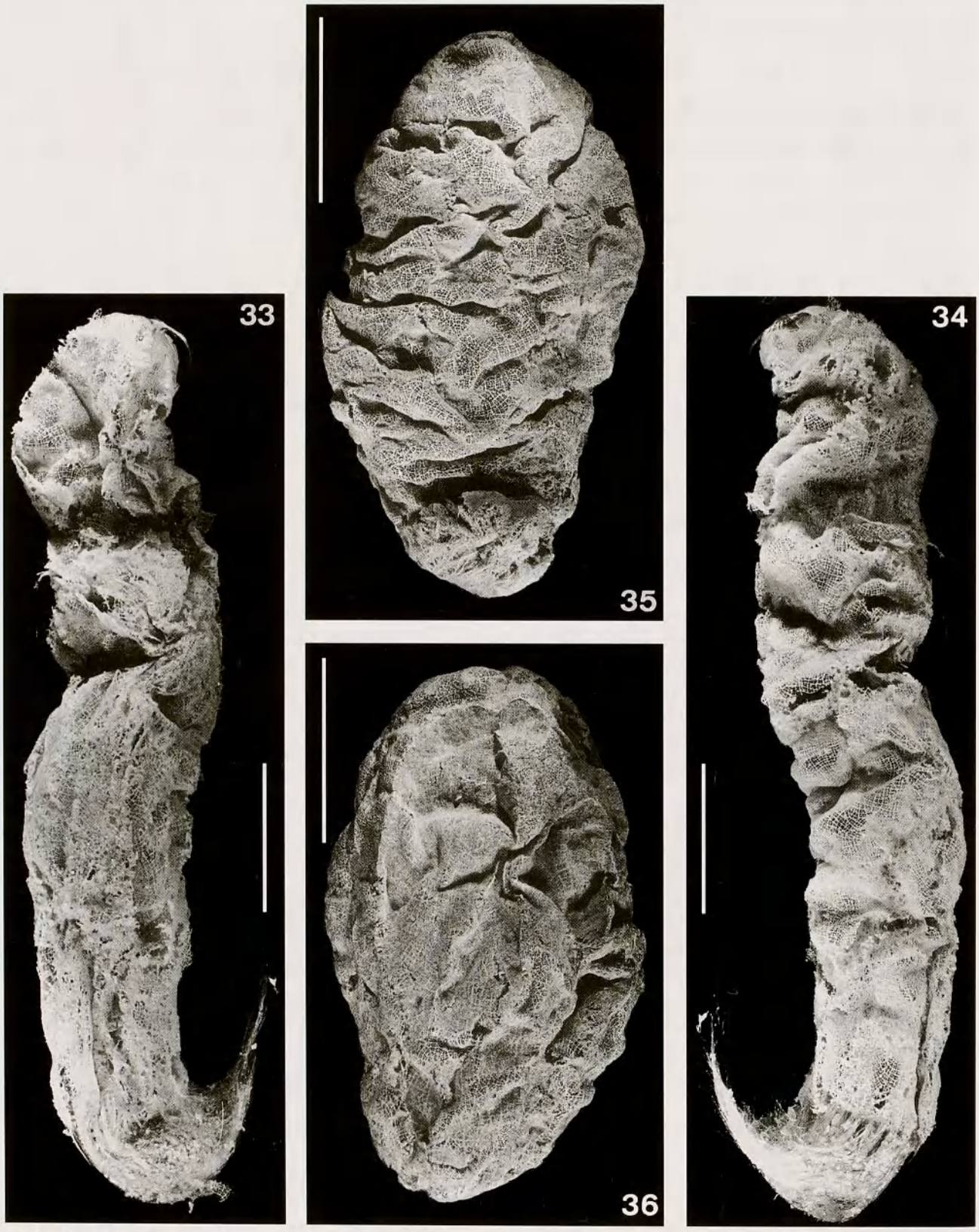

FIG. 33-36. — *Semperella crosnieri* sp. nov.: **33-34**, (HCL 211). Scales = 5 cm; **35-36**, (HCL 210). Scales = 10 cm.

Source : MNHN, Paris

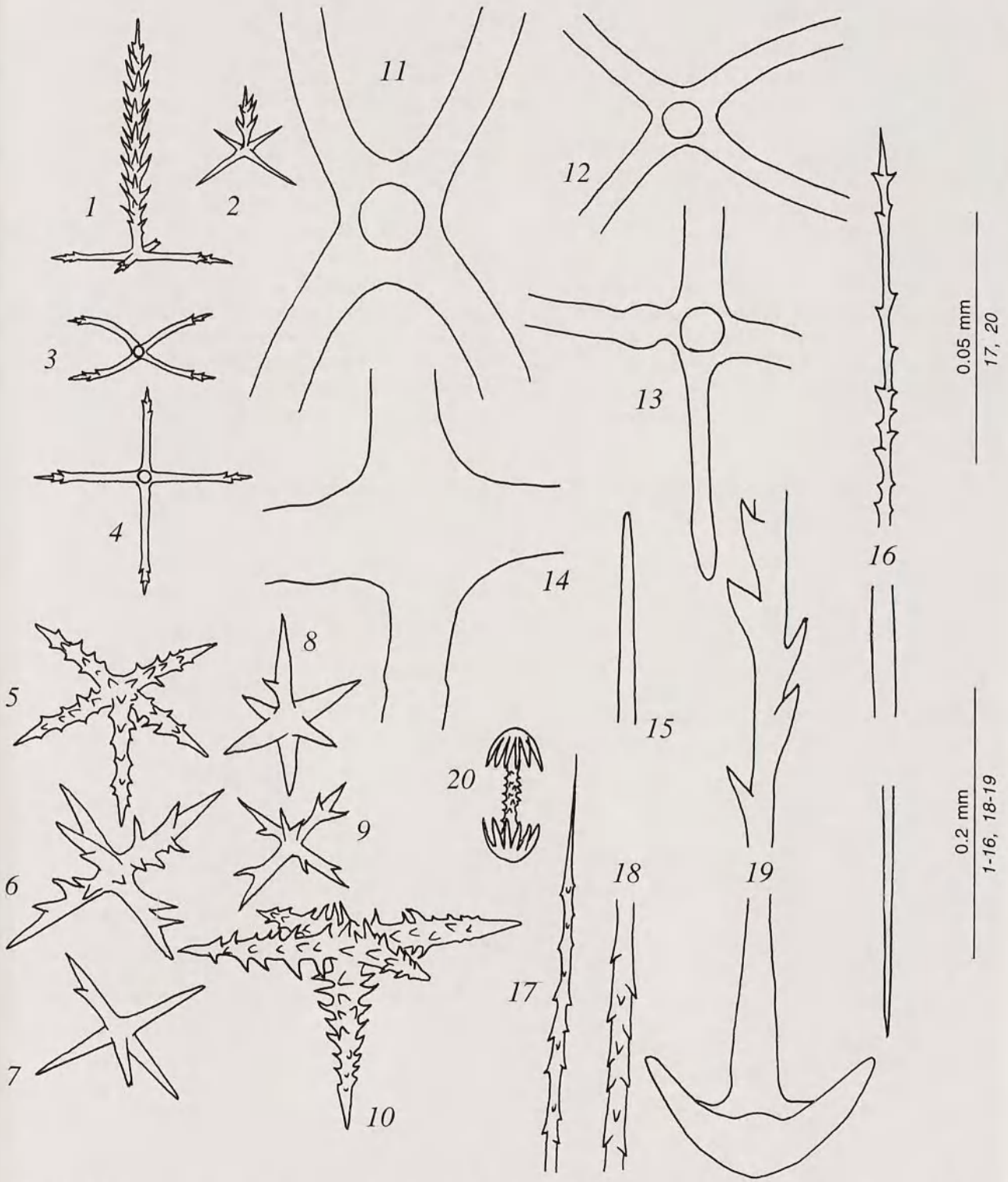

FIG. 37. — *Semperella crosnieri* sp. nov.: **1-2**, dermal pinular pentactins (HCL 209); **3-4**, tangential rays of dermal pentactins (HCL 209); **5-7**, **9-10**, micropentactins (5-6, 9-10, HCL 209; 7, HCL 212); **8**, microhexactin (HCL 212); **11-13**, choanosomal pentactins (HCL 209); **14**, choanosomal stauractin (HCL 209); **15**, outer end of choanosomal spicule (HCL 209); **16**, sceptre (HCL 211); **17**, micruncinate (HCL 210); **18**, macruncinate (HCL 210); **19**, anchorate basalia (HCL 211); **20**, amphidisc (HCL 209).

Source : MNHN, Paris

isolated as single or in groups on all sides of the conical body (IJIMA, 1927). If the specimen is damaged it may be difficult to find dermal and atrial surfaces and hence difficult to relate the specimen to one of the two genera. The atrial surfaces vary notably. *S. schultzei* has atrial surfaces shaped as several thin bands (IJIMA & OKADA, 1938). Atrial surfaces of *S. stomata* (Ijima & Okada, 1938) and probably of *S. spicifera* (Schulze, 1904) underline numerous separate oscules. Atrial surfaces of *S. cucumis* appear as numerous rounded spots of excavated atrial cavities (SCHULZE, 1904). That of *S. alba* is represented by two opposite sides of squared section body (TABACHNICK, 1988). The external body shape of the latter is similar to the lower square part of *P. micropentactinus* (described below). The new species of *Semperella* have the following external body shape: *S. abyssalis* is similar to *S. schulzei; S. crosnieri* similar to *S. cucumis* but the spots of atrial surfaces of *S. crosnieri* are larger; *S. varioactina* is probably close to *S. spicifera*. The shapes and combinations of spicules are more important for the identification of the new species of *Semperella.*

S. varioactina is distinguished by the following features: micropentactins, microstauractins and micromonactins prevail upon the analogous spicules; two types of amphidiscs are present; macramphidiscs may have spherical umbels (due to curved teeth). *S. crosnieri* has pinular pentactins equal to those of *S. varioactina* and similar in shape to those of *S. schultzei.* A single type of amphidisc is known: micramphidisc. Micropentactins have thick rays with numerous long spines, as in *S. stomata* but sometimes the spines are sparse. *S. abyssalis* has pinular pentactins with widened upper part, two types of amphidiscs, and the macramphidiscs with an extremely elongated shaft.

ETYMOLOGY. — This species name refers to Alain CROSNIER, zoologist and oceanographer.

Genus ***POLIOPOGON*** Thomson, 1873

DIAGNOSIS (after SCHULZE, 1886). — The body has the form of either a thick-walled goblet or an ear-shaped involute plate. It has a broad basal tuft and an oscular fringe of marginalia, but no laterally projecting pleuralia. The parenchyma contains small and extremely rough or spinose oxyhexacts and uncinates. In one species, even small smooth oxydiacts vary in size and abundance. The two teeth of the basal anchors are arranged approximately at the right angles of the long, almost smooth shaft. The marginalia end externally in club-shaped thickenings.

TYPE SPECIES. — *Poliopogon amadou* Schulze, 1887.

Poliopogon micropentactinus sp. nov.

Fig. 38-44; Tab. 19-20

MATERIAL EXAMINED. — **New Caledonia**. BIOCAL: stn CP 60, 23°58.87'S, 167°07.72'E, 1530-1480 m, 2.09.1985: HCL 214. — Stn CP 62, 24°19.35'S, 167°49.43'E, 1410 m, 2.09.1985: HCL 215. — Stn CP 63, 24°26.97'S, 168°08.17'E, 2160 m, 2.09.1985: HCL 454-457.
Loyalty Islands. BIOGEOCAL: stn CP 272, 21°00.04'S, 166°56.94'E, 1615-1710 m, 20.04.1987: HCL 213.

TYPES. — *Holotype*: HCL 213 (BIOGEOCAL, stn CP 272, 21°00.04'S, 166°56.94'E, 1615-1710 m).
Paratypes: all the other specimens mentioned above.

DESCRIPTION. — The holotype is a tongue-like sponge 480 mm in long and 80x30 mm in section. Basalia are about 60 mm long. The paratype HCL 214 is over 270 mm long, 60 x 20 mm in section. The paratype HCL 215 is over 600 mm long. In section it shows a square with one opposite convex pair and the other concave as some *Semperella.* Other paratypes are represented as fragments that are rather shaped like *Poliopogon.*

Spicules: The choanosomal skeleton consists of pentactins (fig. 44.4-8), with rays from 0.2 to over several mm in length and 0.02-0.76 mm in diameter. The length of these rays differs notably. Uncinates (fig. 44.9) are

Source : MNHN, Paris

FIG. 38-39. — *Poliopogon micropentactinus* sp. nov. (HCL 213). Scale = 10 cm.

Source : MNHN, Paris

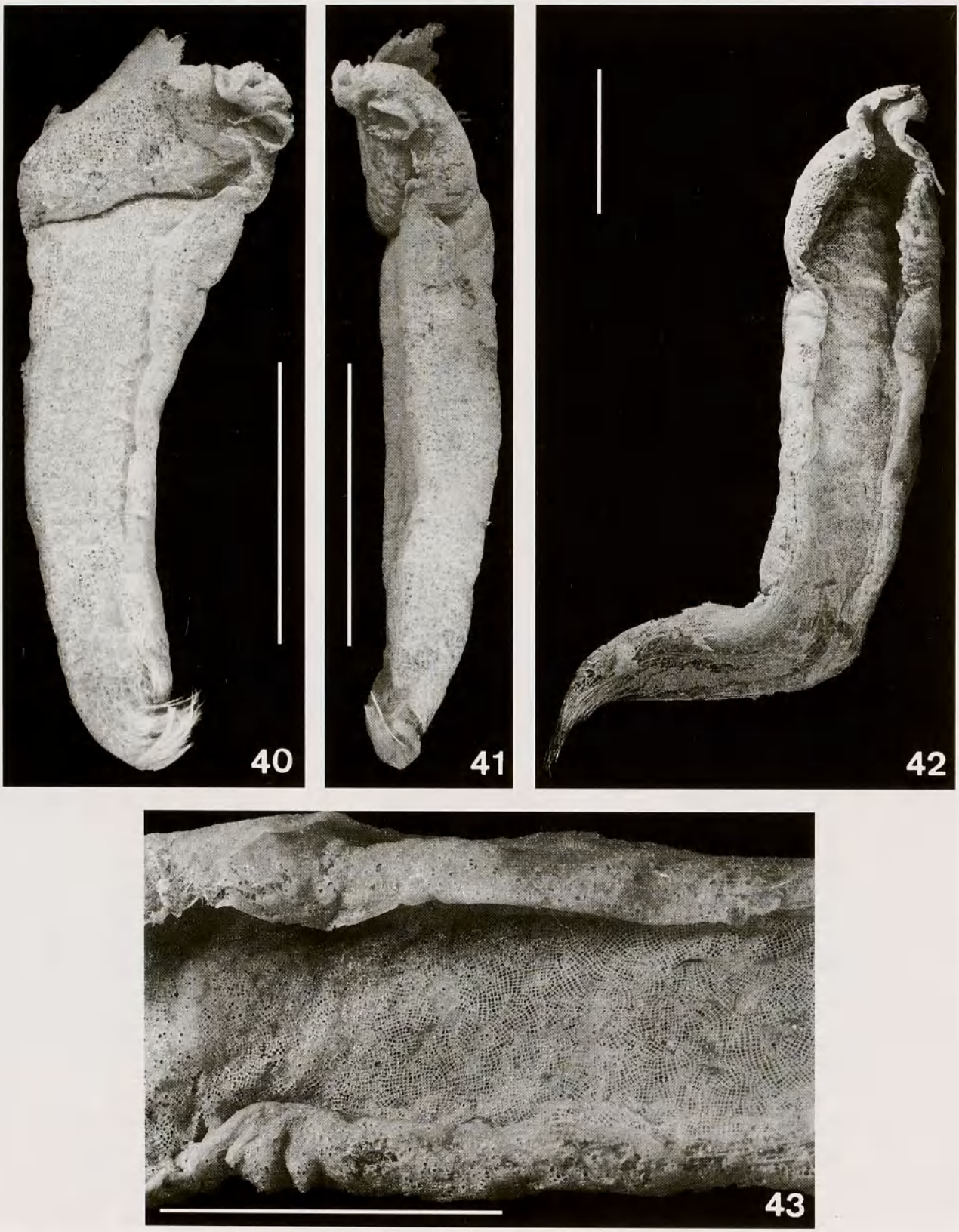

FIG. 40-43. — *Poliopogon micropentactinus* sp. nov.: **40-41**, (HCL 215); **42-43**, (HCL 214). Scales = 10 cm.

Source : MNHN, Paris

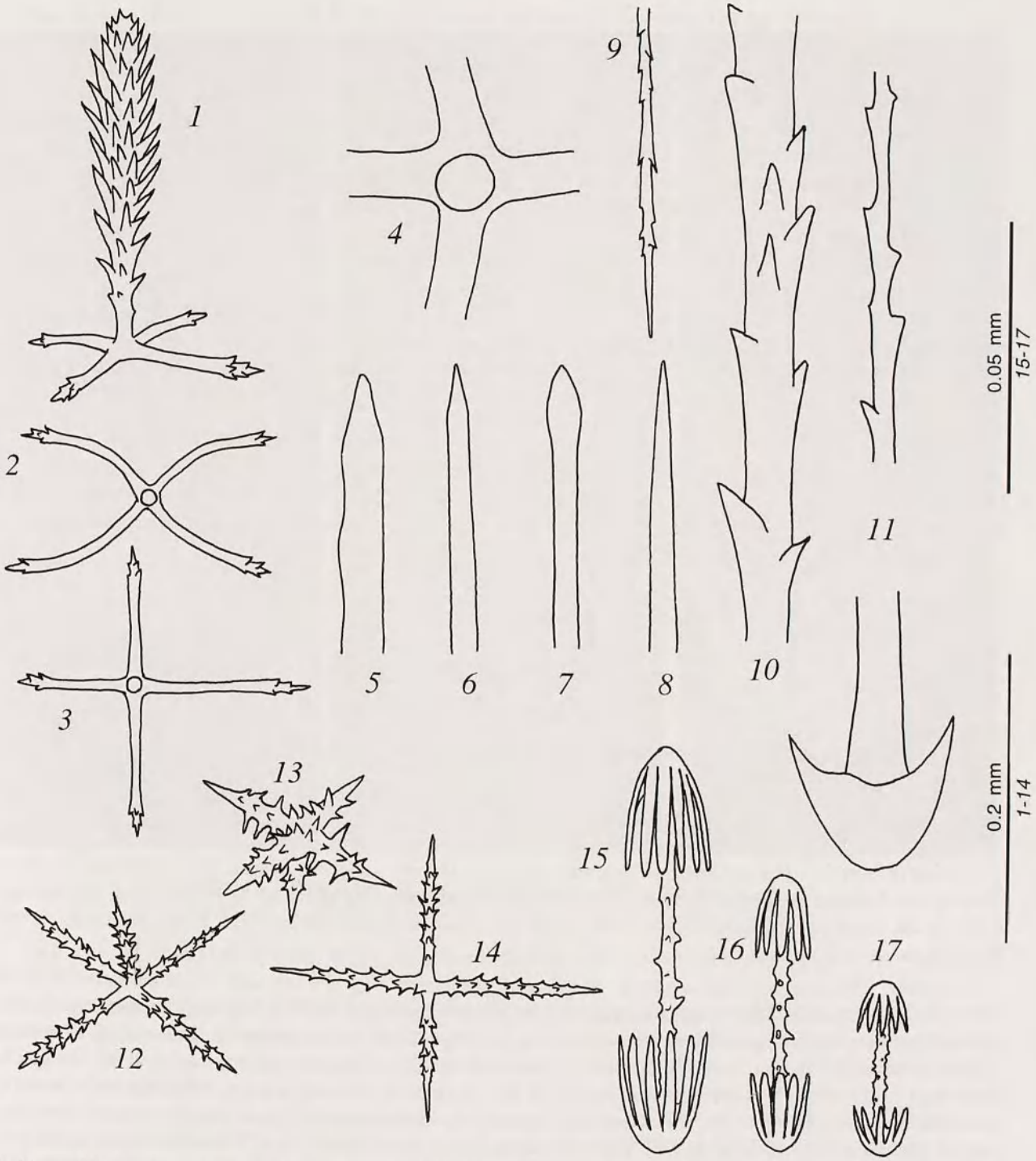

FIG. 44. — *Poliopogon micropentactinus* sp. nov. (HCL 213): **1**, dermal pinular pentactin; **2-3**, tangential rays of dermal pinular pentactin; **4**, choanosomal pentactin; **5-8**, outer ends of choanosomal pentactins; **9**, uncinate; **10**, shaft of anchorate basalia; **11**, anchorate basalia; **12-13**, micropentactins; **14**, microstauractin; **15-17**, amphidiscs.

0.002-0.009 mm in diameter. Basalia (fig. 44.10-11) were found in the holotype only; they are anchor-like, two toothed spicules, the shaft 0.01-0.04 mm in diameter covered with spines. Which surface between two opposite parts is atrial and which is dermal, as it must be in *Poliopogon*, has not be determined so that spicules are discussed as spicules from different sides. The careful examination of the pinular pentactins in the specimen

Source : MNHN, Paris

HCL 215 has shown the great similarity of statistical parameters of all four surfaces (two convex and two concave), whereas the spicules of the ribs between two neighbours surfaces are notably larger. If they corresponded to the atrial surface, this sponge should be transferred to the genus *Semperella*. The increased size of the pinular pentactins from the ribs in HCL 215 can be a result of their marginal position. Pinular pentactins and rare hexactins from both surfaces in other species of the genus are similar in size and shape. The pinular ray (fig. 44.1-3) widens toward the end, ending with a relatively thick end with several short spines. The spines are directed upward and they occur near the base. The tangential rays could make a regular crest or two, the opposite rays are bent in X-form. The tangential rays are smooth with outer ends or even half of a ray covered with short spines directed upward. The pinular ray of pentactins from one side is 0.122-0.334/0.011-0.026 mm, from the other, 0.114-0.262/0.0011-0.026 mm. The tangential rays of pentactins from one side is 0.034-0.148/0.007-0.011 mm, from the other, 0.034-0.122/0.007-0.011 mm.

Micropentactins and rare microstauractins (fig. 44.12-14) are covered with short spines. They have thick or thin rays. The rays (0.052-0.198/0.006-0.017 mm) are covered with spines.

All the amphidiscs (fig. 44.15-17) belong to one type. The largest are about two times larger than the smallest. The amphidisc shafts are covered with short spines. Total length of amphidiscs is 0.015-0.115 mm, umbel length 0.005-0.041 mm, umbel diameter 0.005-0.026 mm.

REMARKS. — This new species of *Poliopogon* differs notably from other species of the genus [*P. amadou* (Schulze, 1887), *P. amadou pacifica* (Tabachnick, 1988), *P. maitai* (Tabachnick, 1988)]. *P. micropentactinus* has micropentactins instead of microhexactins and micropentactins, which are rarely found in other species. It has one type of amphidisc, dermal and atrial pentactins may have the tangential rays curved.

ETYMOLOGY. — The species name refers to the prevalence of micropentactins.

Poliopogon claviculus sp. nov.

Fig. 45, 48; Tab. 21

MATERIAL EXAMINED. — **New Caledonia**. HALIPRO 2: stn BT 25, 25°17.45'S, 170°23.93'E, 1100-1348 m, 11.11.1996: HCL 458.

TYPES. — *Holotype*: HCL 458 (HALIPRO 2, stn BT 25, 25°17.45'S, 170°23.93'E, 1100-1348 m).

DESCRIPTION. — The holotype is a conical sponge 300 mm long and about 120 x 100 mm in section. Atrialia is a flattened concave area about 200 x 50 mm. Basalia are very short, up to 10 mm long. The sponge is fixed by its basal part to a dead cylindrical fragment of hexactinellid sponge with fused skeleton, probably *Tretopleura*.

Spicules: The choanosomal skeleton consists of pentactins (fig. 48.18) and rare stauractins with rays 0.072-0.972/0.014-0.022 mm. Uncinates (fig. 48.11-12) are 0.191-0.828/0.002-0.007 mm. Basalia (fig. 48.7) are anchor-like, two-toothed spicules and monaxons (fig. 48.6), with one outer rounded end. The shaft of anchorate basalia is about 0.006 mm in diameter, probably smooth. Basal monaxons with rounded end are thick, about 0.050 mm in diameter. Other spicules of prostalia are very specific to this species. They are monaxons with clavate distal ends (fig. 48.8-10), which can have spines only on the top and beyond the clavate part. The prostal parts of these spicules are common with other representatives of Pheronematidae. Clavate monaxons are numerous in dermal area and particularly numerous among basalia, they are 0.220-0.396 mm long, 0.004-0.005 mm in diameter of main shaft and 0.014-0.022 mm in diameter of their clavate parts. Dermal and atrial pentactins are pinular pentactins (fig. 48.1-5) similar to each other in shape. Dermal pentactins can be about two times larger than the atrial ones. The pinular ray of these spicules often has a thin spine or its outer end which protrudes far beyond the last spines. The pinular ray of dermal pentactins is 0.078-0.392/0.011-0.025 mm, tangential ones are 0.044-0.096/0.007-0.016 mm. The pinular ray of atrial pentactins is 0.078-0.174/0.022-0.029 mm, tangential

Source : MNHN, Paris

FIG. 45. — *Poliopogon claviculus* sp. nov. (HCL 458). Scale = 10 cm.
FIG. 46-47. — *Poliopogon zonecus* sp. nov. (HCL 459). Scale = 10 cm.

ones are 0.030-0.078/0.011-0.014 mm. Micropentactins (fig. 48.13) are covered with short spines. They have rays 0.061-0.122/0.004 mm.

Amphidiscs are of three types. Macramphidiscs (fig. 48.14-15) are oval, almost round, with smooth shafts and teeth that nearly meet at the equator. The umbel teeth are often broad but sometimes thin and long with some short spines on their surface. Total length of macramphidiscs 0.131-0.287 mm, the umbel diameter 0.070-0.183 mm. Mesamphidiscs and micramphidiscs (fig. 48.16-17) are similar in shape. They have spiny shafts and are different in sizes. Total length of mesamphidiscs 0.061-0.200 mm, the umbel length 0.017-0.078 mm, the umbel diameter 0.010-0.052 mm. Total length of micramphidiscs 0.032-0.058 mm, umbel length 0.012-0.018 mm, umbel diameter 0.008-0.016 mm.

REMARKS. — *Poliopogon claviculus* can be easily distinguished from the other species. It has oval macramphidiscs and prostalia lateralia, and monactins with clavate outer ends. A similar sponge with similar characteristic spicules was found off Hawaii Islands. It is very likely that it belongs to *Poliopogon claviculus* (REISWIG, personal communication).

ETYMOLOGY. — The specific name *claviculus* refers to the shape of the prostalia spicules.

Source : MNHN, Paris

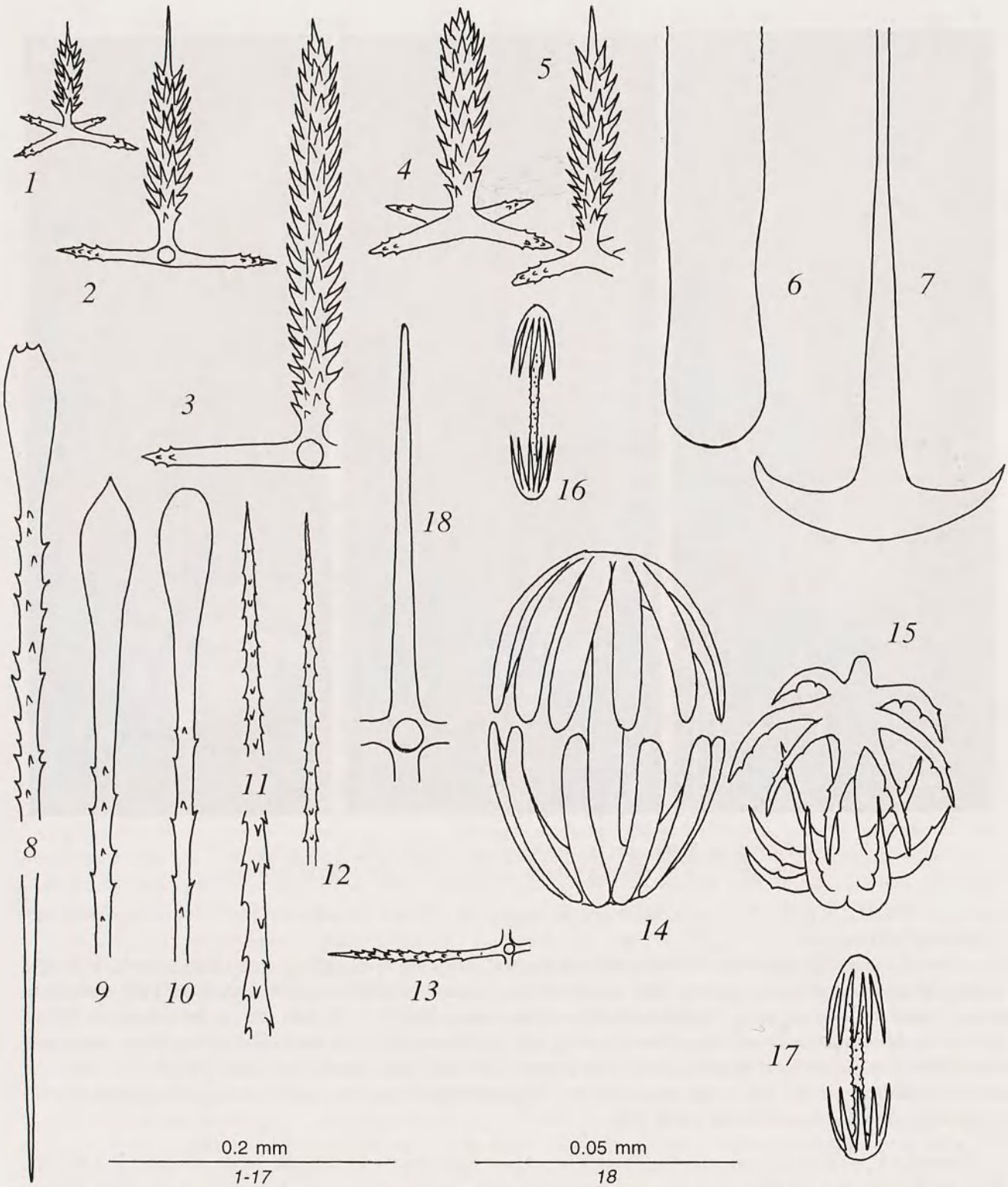

FIG. 48. — *Poliopogon claviculus* sp. nov. (HCL 458): **1-3**, dermal pinular pentactins; **4-5**, atrial pinular pentactins; **6**, basal monaxon; **7**, anchorate basalia; **8-10**, prostalia lateralia (clavate); **11-12**, uncinates; **13**, micropentactin; **14**, common macramphidisc; **15**, thin-toothed macramphidisc; **16**, mesamphidisc; **17**, micramphidisc; **18**, choanosomal pentactin.

Source : MNHN, Paris

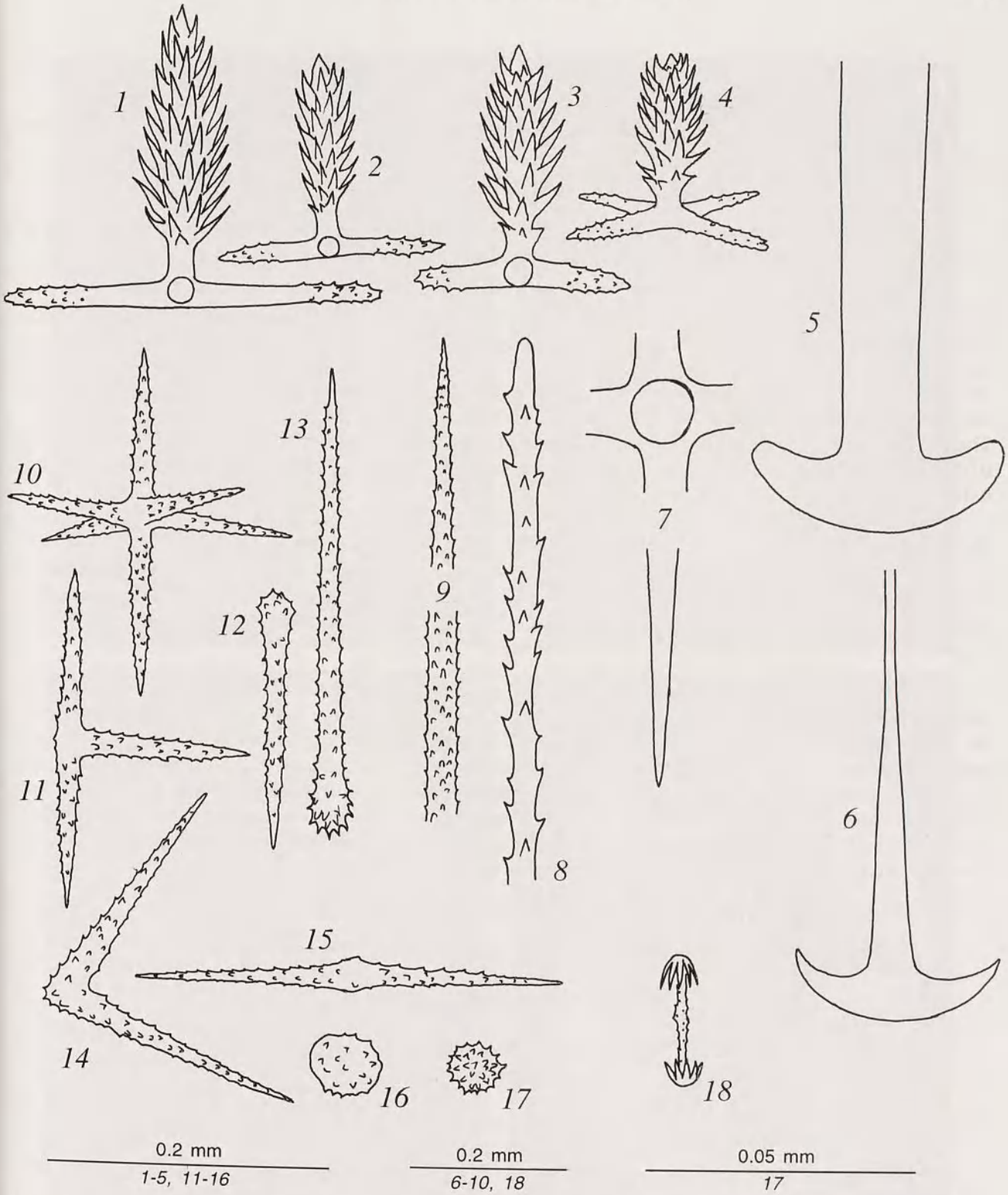

FIG. 49. — *Poliopogon zonecus* sp. nov. (HCL 479): **1-2**, dermal pinular pentactins; **3-4**, atrial pinular pentactins; **5-6**, anchorate basalia; **7**, choanosomal pentactin; **8**, prostalia lateralia (cuspidate); **9**, uncinate; **10**, microhexactin; **11**, microtriactin; **12-13**, micromonactins; **14**, microorthodiactin; **15**, microdiactin; **16-17**, microspheres; **18**, micramphidisc.

Source : MNHN, Paris

Poliopogon zonecus sp. nov.

Fig. 46-47, 49; Tab. 22

MATERIAL EXAMINED. — **New Caledonia**. HALIPRO 2: stn BT 25, 25°17.45'S, 170°23.93'E, 1100-1348 m, 11.11.1996: HCL 459. — Stn BT 32, 25°19.95'S, 168°54.75'E, 697-1340 m, 12.11.1996: HCL 460.

TYPES. — *Holotype*: HCL 459 (HALIPRO 2, stn BT 25, 25°17.45'S, 170°23.93'E, 1100-1348 m).

DESCRIPTION. — The holotype is a tongue-like, elongated, 170 mm long sponge. It is about 75 x 40 mm in section. Tuft of basalia protrudes at about 20 mm. The specimen HCL 460 is a poor fragment.

Spicules: The choanosomal skeleton consists of pentactins (fig. 49.7) rarely of stauractins and tauactins, with rays 0.216-1.080/0.011-0.025 mm. Uncinates (fig. 49.9) (0.367-0.576/0.004-0.005 mm) are covered with very short spines, their surface seems to be rather rough than spinous. Basalia (fig. 49.5-6) are anchor-like, two-toothed spicules with shaft about 0.007 mm in diameter. Prostalia lateralia (fig. 49.8) are monaxons with rounded (not clavate) outer ends. Dermal and atrial pentactins (fig. 49.1-4) are pinular pentactins similar to each other in shape and size. The outer end of pinular ray of these spicules is conical, equal to or not much longer than the last spines. The pinular ray of dermal pentactins is 0.113-0.200/0.022-0.032 mm, tangential rays are 0.070-0.131/0.013-0.018 mm. The pinular ray of atrial pentactins is 0.104-0.191/0.018 mm, tangential ones are 0.061-0.122/0.014-0.018 mm.

Microhexactins and various derivatives (fig. 49.10-17) (micropentactins, microstauractins, microdiactins, micromonactins and spheres) are covered with short numerous spines. These spicules have rays 0.078-0.191/0.014 mm in length. A single type of amphidisc (fig. 49.18) of a more constant total length than that of *Poliopogon micropentactinus* was found in *P. zonecus*. These amphidiscs have shafts covered with numerous short spines and often have a widened part in the middle. Total length of micramphidiscs 0.025-0.047 mm, umbel length 0.006-0.010 mm, umbel diameter 0.007-0.012 mm.

REMARKS. — The specimen HCL 460 is a poor fragment. Its spicule content is incomplete and it is tentatively identified as *P. zonecus* because of similarities of pinular pentactins and micramphidiscs. Microhexactins prevail in this specimen. As this specimen is tentatively identified, it does not receive the paratype status. *Poliopogon zonecus* differs from *P. micropentactinus* in having different microscleres: amphidiscs are smaller; microhexactins and various derivatives are found in *P. zonecus* whereas there are mainly pentactins and some stauractins in *P. micropentactinus*. Some analogues can be found between microhexactins and their derivatives in *P. zonecus* and *Semperella abyssalis* but most other spicules differ strongly in these species. Uncinates with short spines are also one of the characters of this new species.

ETYMOLOGY. — The species is named after the HALIPRO 2-ZONECO cruise.

Genus ***PHERONEMA*** Leidy, 1868

Pheronema pilosum Lévi, 1964

Fig. 50-54; Tab. 23

Pheronema pilosum Lévi, 1964: 99, fig. 54.
Pheronema giganteum - BURTON, 1959: 159 (in part).

MATERIAL EXAMINED. — **Madagascar**. *Northwestern Coast. "Akademic Kurchatov"*, stn 3754, 12°29'S, 48°05'E, 670 m: 5/2/390.9 (IORAN).

Zanzibar area. JOHN MURRAY EXPEDITION: stn 122, 5°21.24'S, 39°23.00'E, 745 m, 22.01.1934: NHM 1936.03.04.080.

Australia. *Eastern Coast*. CIDARIS I: stn 24-2, 17°19.58'S, 147°47.61'E, 1187-1200 m, 11.05.1986: fr870 (provisional number) (MTQ).

Source : MNHN, Paris

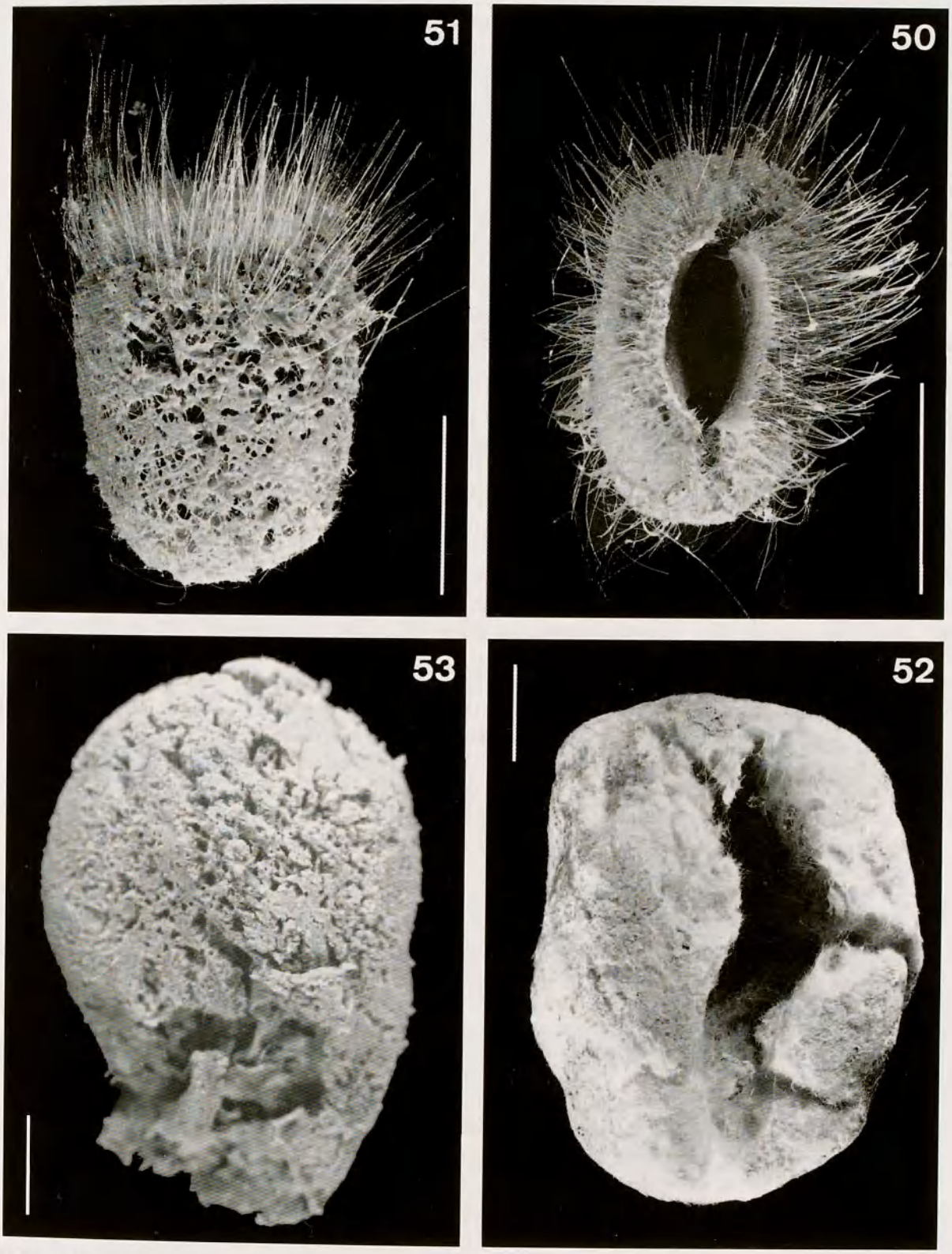

FIG. 50-53. — *Pheronema pilosum* Lévi, 1964: **50-51** (HCL 216); **52** (HCL 256); **53** (HCL 252). Scales = 2 cm.

Source : MNHN, Paris

Indonesia (Flores Sea). *"Snellius"*: stn 164, 7°27.0'S, 124°27.5'E, 200 m: por9402.

Chesterfield Islands. MUSORSTOM 5: stn CP 323, 21°18.52'S, 157°57.62'E, 970 m, 14.10.1986: HCL 229-239. — Stn CP 324, 21°15.01'S, 157°51.33'E, 970 m, 14.10.1985: HCL 242-244. — Stn CP 387, 20°53.41'S, 160°52.14'E, 650-660 m, 22.10.1985: HCL 240-241.

New Caledonia. BIOCAL: stn CP 29, 23°08.70'S, 166°39.70'E, 1100 m, 29.08.1985: HCL 222. — Stn CP 30, 23°09.76'S, 166°40.85'E, 1140 m; 29.08.1985: HCL 225. — Stn CP 57, 23°44.51'S, 166°54.94'E, 1490-1620 m, 1.09.1985: HCL 462. — Stn CP 61, 24°11.67'S, 167°31.37'E, 1070 m, 2.09.1985: HCL 226-227. — Stn CP 62, 24°19.35'S, 167°49.43'E, 1395-1410 m, 2.09.1985: HCL 223-224. — Stn CP 69, 23°52.21'S, 167°57.82'E, 1220-1225 m, 3.09.1985: HCL 228. — Stn CP 75, 22°20.42'S, 167°23.41'E, 825-860 m, 4.09.1985: HCL 216-221, 461.

Loyalty Islands. MUSORSTOM 6: stn CP 427, 20°23.35'S, 166°20.00'E, 800 m, 17.02.1989: HCL 245-247. — Stn CP 438, 20°23.00'S, 166°20.10'E, 780 m, 18.02.1987: HCL 248-249.

BIOGEOCAL: stn CP 297, 20°38.64'S, 167°10.77'E, 1230-1240 m, 28.04.1987: HCL 256.

Combe Bank *(near Wallis and Futuna Islands)*. MUSORSTOM 7: stn CP 551, 12°15.3'S, 177°28.1'W, 791 m, 18.05.1992: HCL 250-252.

TYPES. — Holotype at the Zoologisk Museum in Copenhagen. A spicular slide (MNHN-HCL 28) from the holotype at the Muséum national d'Histoire naturelle in Paris.

DESCRIPTION. — Ovoid sponge from 23 to 120 mm in length, 12 to 65 mm in diameter, with relatively large osculum (8-50 mm in diameter), deep atrial cavity (20-70 mm) and relatively thin walls about 6-25 mm thick. The sponge usually has well developed prostalia lateralia which protrudes at 20-50 mm from the surface and prostalia oscularia. Basalia are different in length but usually not very long.

Spicules: The choanosomal skeleton consists of pentactins and rare hexactins, stauractins and triactins. Basalia and sceptres are similar to those of other species of *Pheronema*. The uncinates belong to three types (fig. 54.13-15). The macruncinates are several mm long and about 0.009 mm in diameter, with spines developed normally. This kind of uncinate is absent in some specimens. The mesuncinates are about 0.7-1.2/0.008 mm, with short spines, and are present everywhere. Small, whip-like micruncinates 0.091-0.912/0.003 mm are tuberculated or rough rather than spinous. This whip-like uncinate is absent in some specimens (HCL 242 and NHM 1936.03.04.080) including the holotype.

Dermalia and atrialia are pinular pentactins (fig. 54.1-8) usually similar to each other in shape and size. The pinular ray of dermal pentactins is 0.046-0.304/0.006-0.026 mm, of atrial, 0.053-0.356/0.006-0.013 mm. The pinular ray is sharply pointed. The whip-like outer end projects freely beyond the last spines. The spines begin at a short distance from the base of the shaft. The pinular ray of atrial pentactins is often curved whereas the dermal one is usually straight. In both specimens collected from the western Indian Ocean (NHM 1936.03.04.080 and IORAN 5/2/390.3) the pinular ray is straight and only the outer end, which projects freely beyond the last spines, may curve slightly. The pinular ray of dermal pentactins of HCL 256 is straight and not very thick, whereas that of the atrial ones is curved or straight. Thickness of atrial pinular ray is similar to that of the dermal one. The atrial pinular ray may be whip-like with rare spines or oval in shape with conical or rounded outer end. Some long spines of pinular ray are dichotomously branched. The tangential rays are rough and sharply pointed. The tangential ray of dermal pentactins is 0.038-0.236/0.006-0.008 mm, of atrial, 0.038-0.205/0.006-0.007 mm.

Micropentactins (fig. 54.9) with rough rays are rare in most specimens and they were not described from the holotype. These micropentactins are canalaria or non developed pinular pentactins as their rays are similar to the tangential rays of pinular pentactins. The rays of these micropentactins are 0.026-0.152/0.006 mm. The microhexactins and microstauractins in addition to micropentactins are present in HCL 256. The microhexactins prevail in HCL 462.

The amphidiscs (fig. 54.15-18), with shafts covered with numerous spines, belong to one type. Total length 0.022-0.189 mm, umbel length 0.007-0.052 mm, umbel diameter 0.008-0.045 mm. Their length varies about 3-4 times between different specimens. However, according to figures of the holotype they also vary about 3 times. The largest amphidiscs were observed in HCL 220, 232, 248, the smallest ones in HCL 217, 221, 222, 226, 243. According to the length of amphidiscs of other species of *Pheronema*, the amphidiscs of *P. pilosum* correspond both to micramphidiscs and mesamphidiscs. They were described as mesamphidiscs in the original description. In the close species, *P. amphorae* (Reiswig, 1992), these spicules are divided into micramphidiscs and mesamphidiscs. Some specimens have fragments of these micramphidiscs, probably of allochtonous origin.

Source : MNHN, Paris

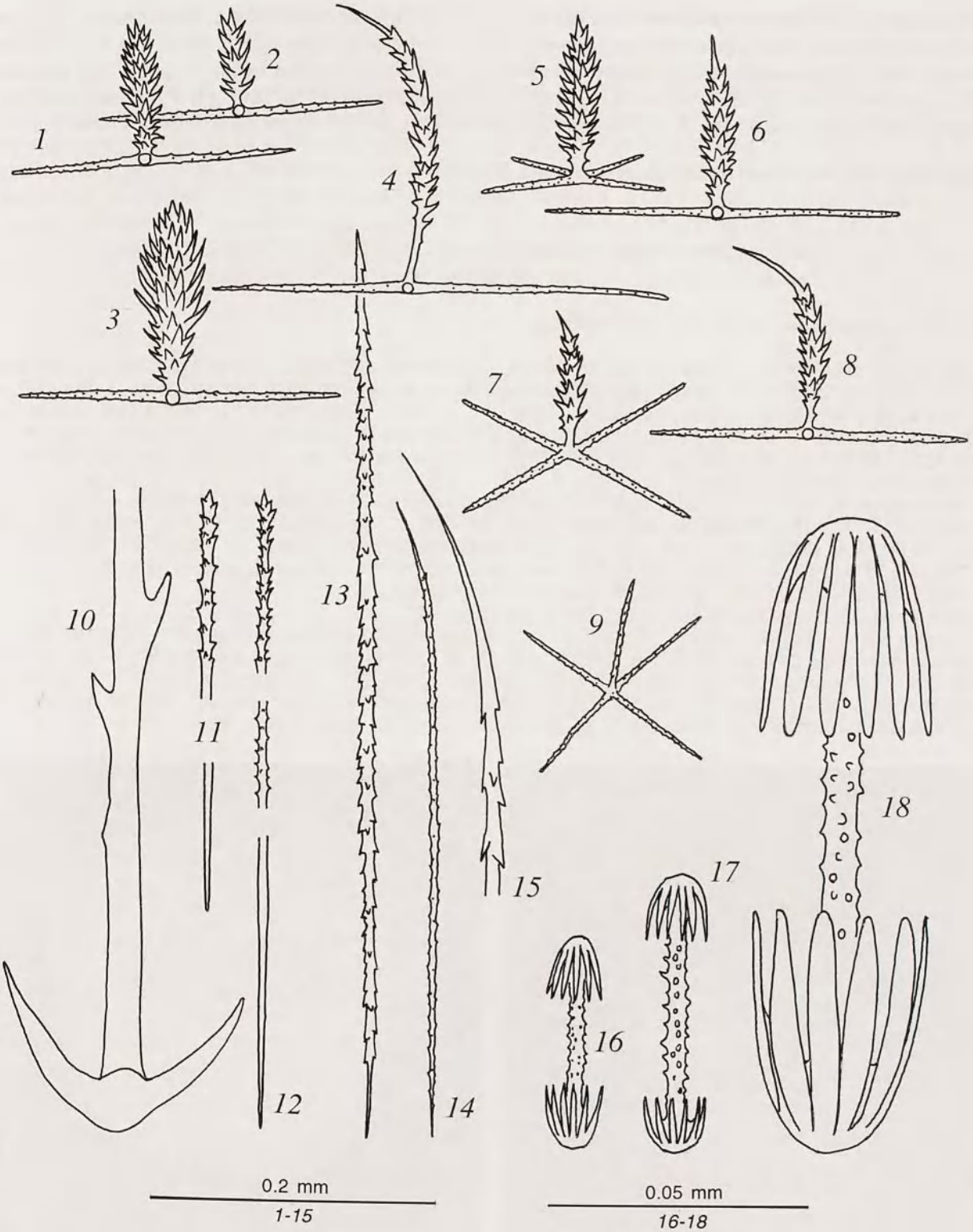

FIG. 54. — *Pheronema pilosum* Lévi, 1964: **1-4**, dermal pentactins (1-2, HCL 461; 3, HCL 242; 4, HCL 220); **5-8**, atrial pentactins (5-6, HCL 461; 7, 5/2/390.9; 8, HCL 461); **9**, micropentactin (HCL 461); **10**, anchor-like basalia (HCL 461); **11**, sceptre (HCL 461); **12**, sceptre (5/2/390.9); **13**, mesuncinate (HCL 461); **14**, micruncinate (HCL 461); **15**, macruncinate (HCL 461); **16**, amphidisc (HCL 461); **17**, amphidisc (HCL 243); **18**, amphidisc (HCL 220).

Source : MNHN, Paris

REMARKS. — *Pheronema pilosum* is widely distributed in the Indo-west Pacific. The closest species are *P. echinatum* (Ijima, 1927), *P. amphorae* (Reiswig, 1992), *P. barbulosclera* (Lévi, 1964) and *P. carpenteri* (Schulze, 1887). Unfortunately, the specimens collected from the coast of Zanzibar by the *"Valdivia"* and identified as *P. carpenteri* (SCHULZE, 1904) were not correctly described. They could also belong to *P. pilosum* since they were collected in the Indian Ocean. If so, *P. carpenteri* inhabits only the central and north Atlantic Ocean.

DISTRIBUTION. — Indian Ocean, Indonesia, western Pacific.

Pheronema semiglobosum Lévi & Lévi, 1982

Fig. 55-57; Tab. 24

Pheronema semiglobosum Lévi & Lévi, 1982: 286, fig. 2, pl. 2-3.

MATERIAL EXAMINED. — **New Caledonia**. BIOCAL: stn DW 08, 20°35.09'S, 166°54.05'E, 435 m, 12.08.1985: HCL 261-267. — Stn DW 37, 23°00.07'S, 167°16.34'E, 350 m, 30.08.1985: HCL 268-270, 496. — Stn DW 44, 22°47.35'S, 167°14.50'E, 440-450 m, 30.08.1985: HCL 271. — Stn CP 45, 22°47.87'S, 167°15.94'E, 430-465 m, 30.08.1985: HCL 260. — Stn DW 46, 22°53.27'S, 167°17.41'E, 570-610 m, 30.08.1985: HCL 272-275. — Stn DW 51, 23°05.43'S, 167°45.35'E, 680-700 m, 31.08.1985: HCL 276. — Stn DW 83, 20°35.25'S, 166°54.03'E, 460 m, 6.09.1985: HCL 278-279, 293-294.

MUSORSTOM 4: stn CP 213, 22°51.30'S, 167°12.00'E, 405-430 m, 28.09.1985: HCL 284-286. — Stn CP 214, 22°53.80'S, 167°13.90'E, 425-440 m, 28.09.1985: HCL 287-288. — Stn CP 215, 22°55.70'S, 167°17.00'E, 485-520 m, 28.09.1985: HCL 289. — Stn DW 229, 22°51.60'S, 167°13.50'E, 445-460 m, 30.09.1985: HCL 290. — Stn DW 230, 22°52.50'S, 167°11.80'E, 390-420 m, 30.09.1985: HCL 291. — No station number: HCL 292.

SMIB 1: stn DW 2, 22°51.9'S, 167°13'E, 415 m, 5.02.1986: HCL 306.

SMIB 4: stn DW 54, 23°40.1'S, 168°00.2'E, 235 m, 9.03.1989: HCL 307.

Loyalty Islands. BIOGEOCAL: stn DW 307, 20°35.38'S, 166°55.25'E, 470-480 m, 1.05.1987: HCL 280-283.

MUSORSTOM 6: stn DW 391, 20°47.35'S, 167°05.70'E, 390 m, 13.02.1989: HCL 295-298, 463-465. — Stn DW 406, 20°40.65'S, 167°06.80'E, 373 m, 15.02.1989: HCL 299-300. — Stn DW 448, 20°55.66'S, 167°22.34'E, 410 m, 19.02.1989: HCL 301. — Stn DW 458, 21°00.93'S, 167°29.96'E, 400 m, 20.02.1989: HCL 302. — St. DW 487, 21°23.30'S, 167°46.40'E, 500 m, 23.02.1989: HCL 303-304. — No station number: HCL 305.

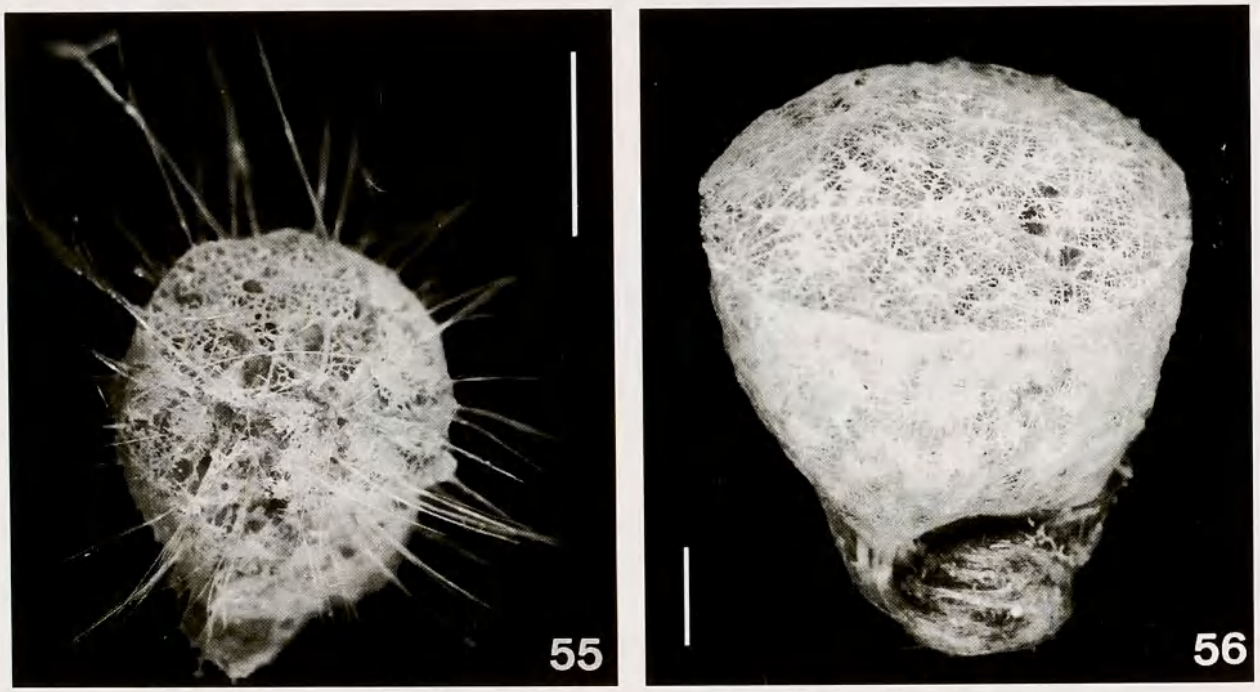

FIG. 55-56. — *Pheronema semiglobosum* Lévi & Lévi, 1982: **55** (HCL 298); **56** (HCL 294). Scales 2 cm.

Source : MNHN, Paris

TYPES. — *Holotype*: HCl 48. *Paratypes*: HCl 49 - 17 specimens (New Caledonia, 22°46'S, 167°14'E, 400-410 m).

DESCRIPTION. — The body is usually hemispherical, rarely oval (HCL 282) or spherical (HCL 304). The tufts of pleuralia oscularia and pleuralia lateralia protrude at about 5-40 mm. In one spherical sponge (HCL 304), pleuralia atrialia similar to those of dermalia are found over the atrial surface. Basalia are usually about 30 mm in length. The sponge (one of the paratypes) about 13 mm long and 13 x 8 mm in diameter has no prostalia or basalia. The other paratype is 7 mm long and 12 x 10 mm in diameter, it has no basalia and no prostalia oscularia. The specimen HCL 304 mentioned above is about 15 mm in diameter. The oval sponge HCL 282 is rather large, about 55 mm long and 50 x 30 mm in diameter. One of the small specimens (HCL 496) has a slightly depressed atrial cavity. The largest specimen (HCL 278) is120 mm long and 130x155 mm in diameter.

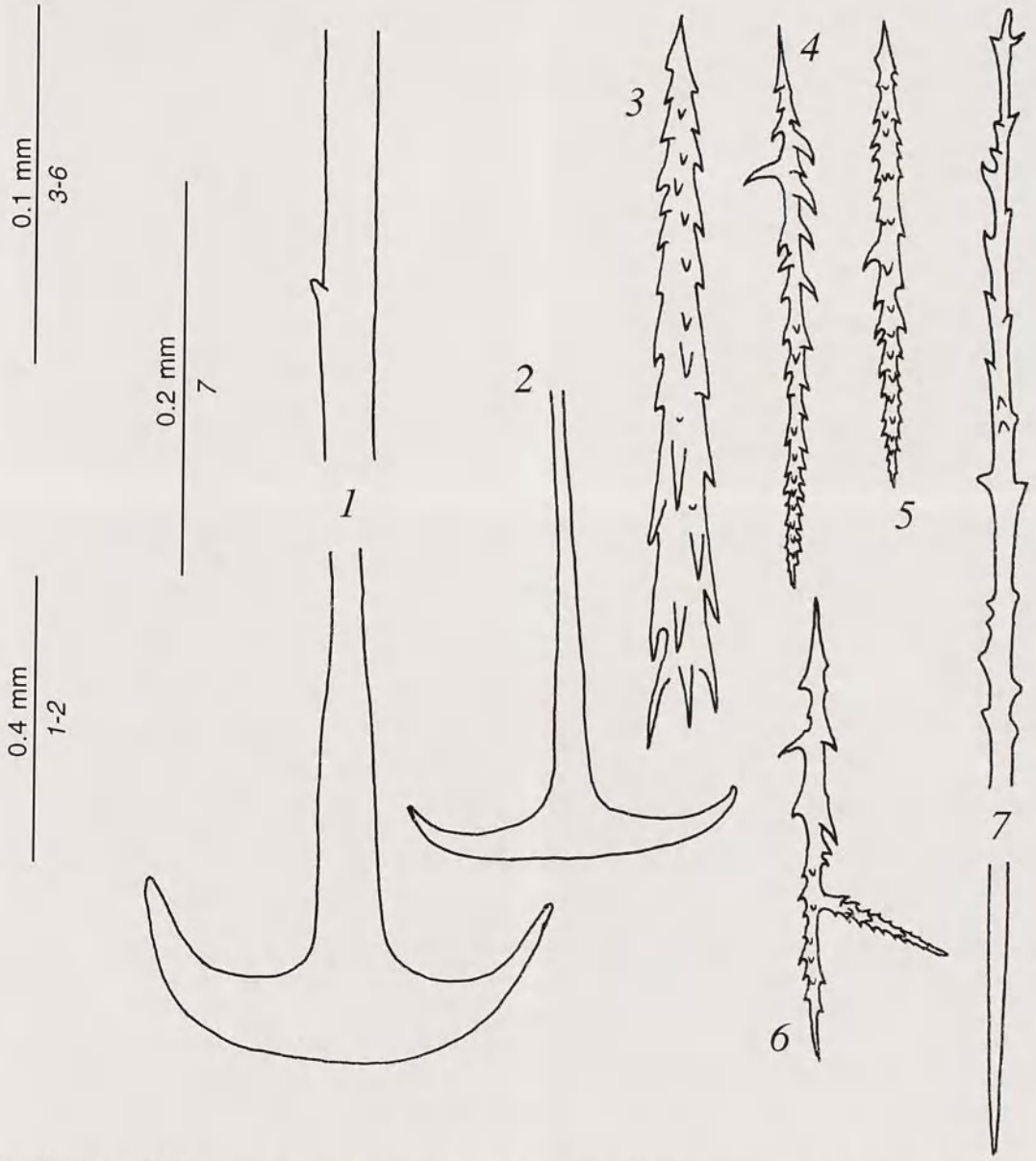

FIG. 57. — Spicules of *Pheronema semiglobosum* Lévi & Lévi, 1982 (types, except 4-5, HCL 278): **1-2**, anchorate basalia; **3**, macruncinate; **4-6**, micruncinates; **7**, sceptre.

Source : MNHN, Paris

Additional remarks on the skeleton spicules:

Hexactins prevail over pentactins in the choanosomal skeleton in some specimens (e.g. HCL 304). The basalia sometimes have some teeth located at a short part of the rachis.

Prostalia oscularia and lateralia are sceptres (fig. 57.7) as in other *Pheronema*. The micruncinates (fig. 57.4-6) are rare in the smallest specimens (HCL 304, 287, 282) and in two smallest paratypes; they seem to be absent in HCL 278. Only two mesuncinates have been found in the smallest paratype specimen but they belong to macruncinates (fig. 57.3) rather than to micruncinates. The micruncinates are 0.084-0.646 mm long.

Dermalia and atrialia are pinular pentactins and, rarely, hexactins similar in shape. The pinular ray of dermal pentactins is 0.053-0.236 mm, of atrial, 0.076-0.372 mm. The pinular ray is straight or curved. The tangential rays are entirely or partly (the upper end) covered with numerous spines. The tangential rays are straight or two opposite pairs bent in an X-form. From side view the tangential rays are always slightly deviated away from the pinular ray. The tangential ray of dermal pentactins is 0.023-0.099 mm, of atrial 0.027-0.133 mm.

Total length of macramphidisc 0.068-0.239 mm, umbel length 0.015-0.068 mm, umbel diameter 0.027-0.076 mm. Total length of micramphidisc 0.017-0.065 mm, umbel length 0.005-0.013 mm, umbel diameter 0.005-0.013 mm. Micramphidiscs are rare in the smallest specimen (HCL 496).

DISTRIBUTION. — New Caledonia, Loyalty Islands.

Pheronema conicum Lévi & Lévi, 1982

Fig. 58-63; Tab. 25

Pheronema conicum Lévi & Lévi, 1982: 284, pl. 1 fig. 1.

MATERIAL EXAMINED. — **New Caledonia**. BIOCAL: stn DW 08, 20°35.09'S, 166°54.05'E, 435 m, 12.08.1985: HCL 312-315. — Stn DW 38, 22°59.94'S, 167°15.42'E, 360 m, 30.08.1985: HCL 316. — Stn DW 44, 22°47.35'S, 167°14.50'E, 440-450 m, 30.08.1985: HCL 317-318. — Stn CP 45, 22°47.87'S, 167°15.94'E, 430-465 m, 30.08.1995: HCL 310. — Stn CP 47, 22°53.10'S, 167°16.82'E, 550 m, 30.08.1985: HCL 311. — Stn DW 83, 20°35.25'S, 166°54.03'E, 460 m, 6.09.1985: HCL 319-326.

MUSORSTOM 4: stn DW 228, 22°47.00'S, 167°18.20'E, 420 m, 30.09.1985: HCL 333-335. — Stn DW 230, 22°52.50'S, 167°11.80'E, 390-420 m, 30.09.1985: HCL 337-338, 467. — No station number: HCL 472.

CHALCAL 2: stn CP 25, 23°38.60'S, 167°43.12'E, 418 m, 30.10.1986: HCL 329-332.

CALSUB: stn 19, S to SW of the Isle of Pines, 22°46'S, 167°20'E, 416-404 m, 10.03.1989: HCL 328, 336.

SMIB 1: no station number: HCL 343.

Loyalty Islands. BIOGEOCAL: stn DW 307, 20°35.38'S, 166°55.25'E, 470-480 m, 1.05.1987: HCL 327.

MUSORSTOM 6: stn DW 396, 20°48.05'S, 167°00.59'E, 1400 m, 13.02.1989: HCL 469. — Stn CP 427, 20°23.35'S, 166°20.00'E, 800 m, 17.02.1989: HCL 471. — Stn CP 438, 20°23.00'S, 166°20.10'E, 780 m, 18.02.1989: HCL 470. — Stn DW 487, 21°23.30'S, 167°46.40'E, 500 m, 23.02.1989: HCL 341-342.

Chesterfield Islands. MUSORSTOM 5: stn DW 272, 24°40.91'S, 159°43'E, 500-540 m, 9.10.1986: HCL 466. — Stn DW 300, 22°48.27'S, 159°23.94'E, 450 m, 11.10.1986: HCL 468. — Stn DW 301, 22°06.90'S, 159°24.60'E, 487-610 m, 12.10.1986: HCL 339-340.

TYPES. — *Holotype*: HCL 46. *Paratypes*: HCL 47 - 5 specimens collected from two stations (New Caledonia, 22°49'S, 167°12'E, 390-395 m).

DESCRIPTION. — The body is conical or spherical, with a relatively small osculum and atrial cavity. The body length is 15-150 mm, maximal diameter is 19-130 mm, diameter of the osculum is 1-23 mm, length of the atrial cavity is 12-80 mm. The holotype is 45 mm long and 60 mm in diameter, the diameter of the osculum is 8 mm. The sponge has few basalia and pleuralia lateralia variously developed in different specimens. Pleuralia lateralia protrude at 10-40 mm from the surface. They are found everywhere on the lateral surface and are absent in the vicinity of the osculum. Pleuralia are concentrated sometimes in several tufts. Pleuralia lateralia seem to be entirely absent in some specimens.

Spicules: The choanosomal spicules are pentactins (fig. 62.20) or rarely hexactins and stauractins (fig. 62.18-19), with smooth, rarely rough rays several mm long and 0.02-0.09 mm in diameter. Prostalia lateralia are

Source : MNHN, Paris

diactins, partly smooth and partly rough or entirely smooth, several mm long and about 0.15 mm in diameter. Basalia (fig. 62.22-24) are usual for other Pheronematidae anchorate spicules, with rare spines on the rachis. The macruncinate (fig. 62.11) is thick, 0.010-0.012 mm in diameter, and long, with normally developed spines. The whip-like micruncinates (fig. 62.12) are relatively short, with short spines or rough surface. They are approximately 0.17/0.0015 mm. Dermal spicules differ from the atrial. They both are pinular pentactins (fig. 62.1-10) or rare hexactins. In some specimens (as in one paratype) the dermal hexactins are notably numerous and atrial ones even predominate over the pinular pentactins. The dermal pinular ray is sharply pointed, the upper end

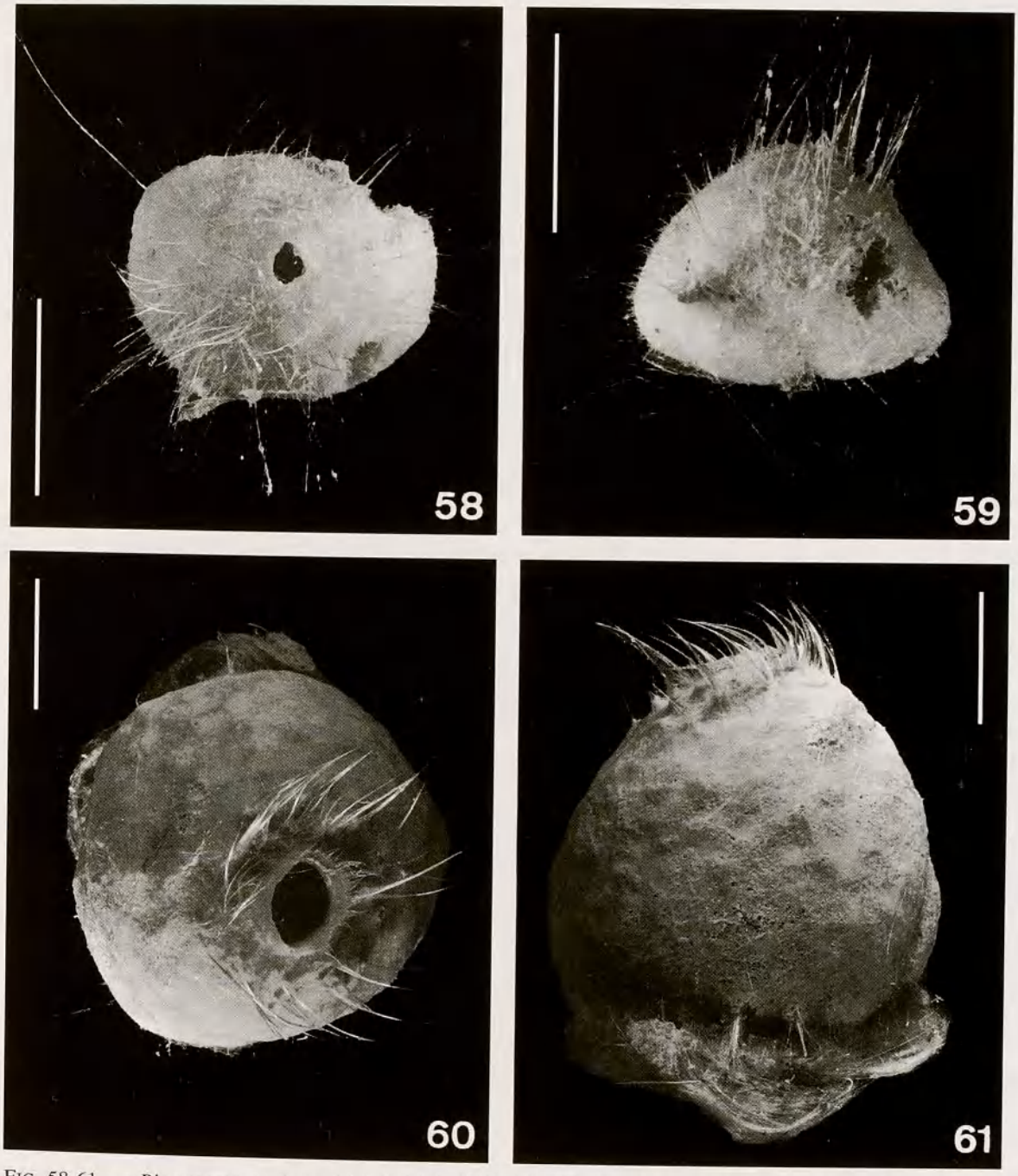

FIG. 58-61. — *Pheronema conicum* Lévi & Lévi, 1982: **58-59** (HCL 328); **60-61** (HCL 336). Scales = 2 cm.

Source : MNHN, Paris

terminates at the same level with the upper spines or sometimes projects beyond the ends of the last spines. Most of the spines are long, hook-like, and are directed upward except the closest one to the base, which may be directed downward. The spines begin at the upper 2/3 of the ray or at a short distance from the base. The tangential rays are not sharply pointed, and are smooth with outer ends rough or short-spiny. Some rarely found dermal and atrial pentactins have few thick and long spines. The pinular ray of the atrial pentactins is long, conically pointed, and the upper end freely projects beyond the ends of last spines. The spines are directed upward, and they cover all the shaft, being relatively short. Some spines near the base may be directed downward; they may split into two spines. The pinular ray of dermal pentactins is 0.049-0.251/0.004-0.007 mm, of atrial 0.053-0.468/0.004-0.011 mm. The tangential rays of the atrial pentactins are covered with numerous short spines. The tangential ray of dermal pentactins is 0.038-0.190/0.004-0.006 mm, of atrial 0.038-0.462/0.004-0.006 mm.

Microhexactins (fig. 62.13-17) covered with short or long spines prevail over the analogous micropentactins and microstauractins. The ray of microhexactins is 0.12-0.22/0.007-0.013 mm. The microtriactins and microdiactins with thick ray covered with spines described in the primary description (LÉVI & LÉVI, 1982) seem to belong to another sponge, probably *Semperella schulzei.* They were observed only in the holotype and paratypes of *P. conicum.* Nearly all the other specimens that were examined had no such spicules.

Amphidiscs located in the vicinity of dermal and atrial surface are different. Two types are found. Macramphidiscs with great variation in size and micramphidiscs more uniform in length. The macramphidiscs (fig. 63.1-20) of the dermal surface are usually larger then the atrial ones, their size variation within a specimen is less distinct but the size variation among specimens is distinct. Total length of dermal macramphidiscs 0.046-0.312 mm, umbel length 0.019-0.106 mm, umbel diameter 0.023-0.106 mm. Most of these amphidiscs are "normal" with the umbels spherical or elongated, whereas some rare forms have the shaft projecting beyond the end of the umbel. Some other dermal macramphidiscs have different sizes of umbels but this difference is not as distinct as in atrial macramphidiscs. Such proportions were previously known for some other species of the genus. The shafts of dermal macramphidiscs are often covered with tubercles or rarely with a few curved spines. In some specimens (e.g. HCL 321) the dermal macramphidiscs were not found. The micramphidiscs from the dermal surface are entirely similar to atrial ones. Total length of dermal micramphidiscs 0.014-0.063 mm, umbel length 0.005-0.020 mm, umbel diameter 0.005-0.014 mm. The atrial macramphidiscs are usually numerous but in some paratypes they are rare. Total length of atrial macramphidiscs 0.038-0.243 mm, the umbel length 0.018-0.084 mm, the umbel diameter 0.014-0.084 mm. In nearly all specimens the atrial macramphidiscs show a very similar variation. If the atrial macramphidiscs are normally developed, the teeth of the umbels may be flattened, tongue-like or rarely spinous, hook-like. Some macramphidiscs have one normally developed umbel, whereas the other has a deformed upper surface, with the shaft protruding over the surface and the lack of some teeth. The other amphidiscs have one reduced umbel, they end with a prolongation of the shaft and have some teeth situated in an irregular manner, often finger-like. Such spicules were described in *Hyalonema thomsoni* (Schulze, 1905). The other deformed macramphidiscs are paradisc-shaped. This type of spicules was previously known in the family Hyalonematidae, only in *Hyalonema (Paradisconema)* (IJIMA, 1927). The next deformed form, hemidiscs, have umbels of different sizes (length and diameter). This type of amphidisc, or birotulates, according to REID (1958a; 1958b; 1961), were previously known in the fossil order Hemidiscosa (SCHRAMMEN, 1924). The proportion between the diameters of the umbels of *Hemidiscella schrammeni* is 3.3 (REID, 1958b), whereas in the paradiscs of *P. conicum* it is not more than 1.2. Another type of deformed macramphidisc has umbels with teeth which meet or even overlap in the equator. These macramphidiscs are usually smaller in size than others but nevertheless they cannot be considered mesamphidiscs because of the absence of overlap in size with such other amphidiscs. As most other deformed amphidiscs, they are usually smaller than normal ones and they may be considered as a type of macramphidiscs rather than mesamphidiscs. The long teeth of macramphidiscs show several deformations. They can turn to be paradiscs. Others demonstrate some fusions. Teeth at each end may merge to form an entire spherical surface. The ends of these teeth are accreted to the middle of a shaft. The whole spicule looks like a pair of joined balls with latitudinal depressions. Fusion of the umbels of the amphidiscs was previously known in *Monorhaphis chuni* (Schulze, 1905) but it is the fusion of the opposite teeth. The shafts of atrial macramphidiscs are usually tuberculated, rarely smooth with a whorl of tubercles in the middle. All the strongly deformed macramphidiscs are smaller than the complete ones. It nevertheless seems to be impossible to distinguish separate

Source : MNHN, Paris

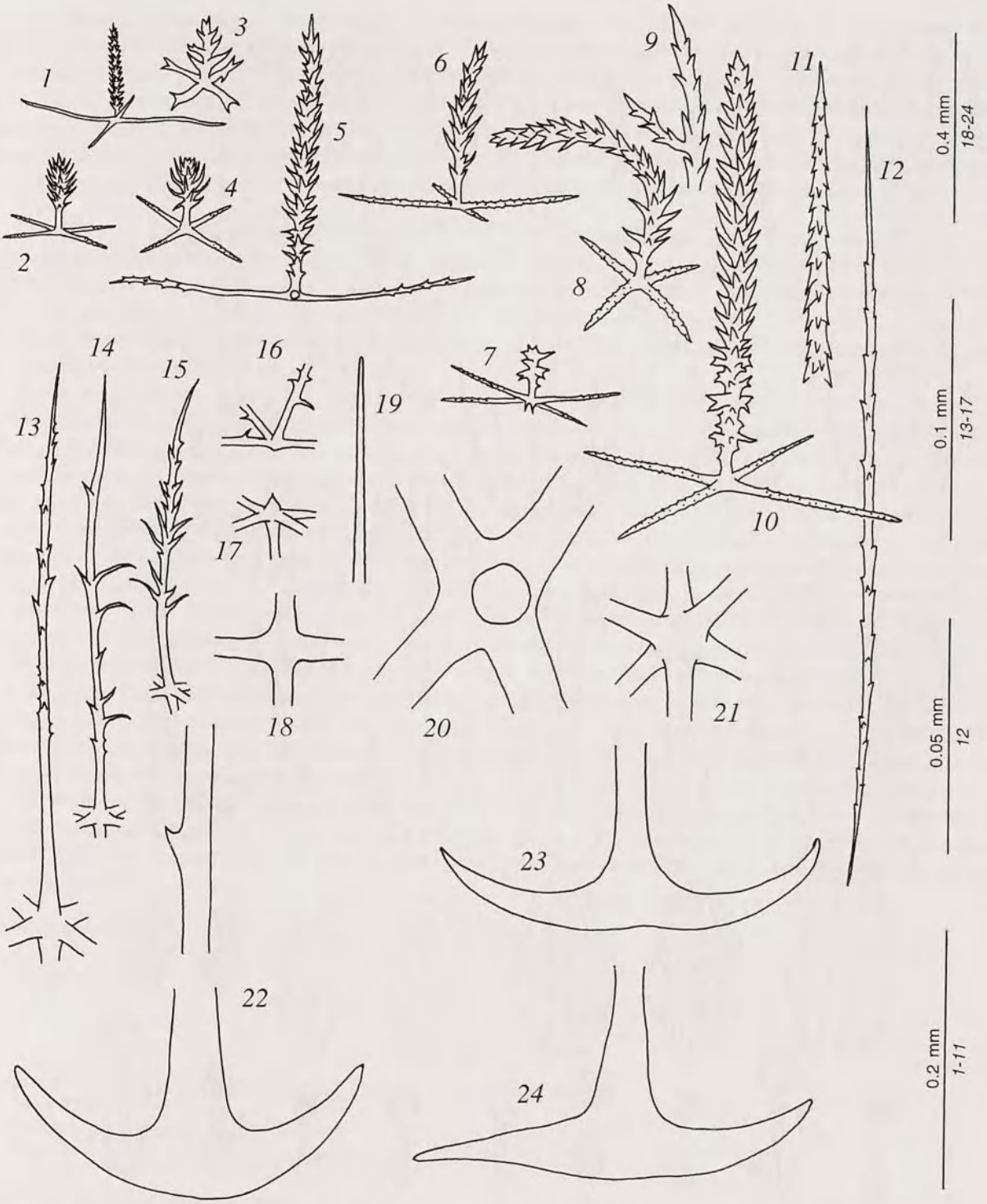

FIG. 62. — Spicules of *Pheronema conicum* Lévi & Lévi (types and others specimens): **1-4**, dermal pinular pentactins (1-2, HCL 334); **5-10**, atrial pinular pentactins (5, HCL 315; 6-8, HCL 314; 9, HCL 324); **11**, macruncinate; **12**, micruncinate; **13-15**, micropentactins (13-14, HCL 340; 15, HCL 439); **16**, microtauactin (HCL 439); **17**, micropentactin (HCL 439); **18**, choanosomal stauractin (HCL 331); **19**, outer end of choanosomal stauractin (HCL 331); **20**, choanosomal pentactin; **21**, choanosomal hexactin (HCL 332); **22-24**, anchorate basalia (24, HCL 322).

Source : MNHN, Paris

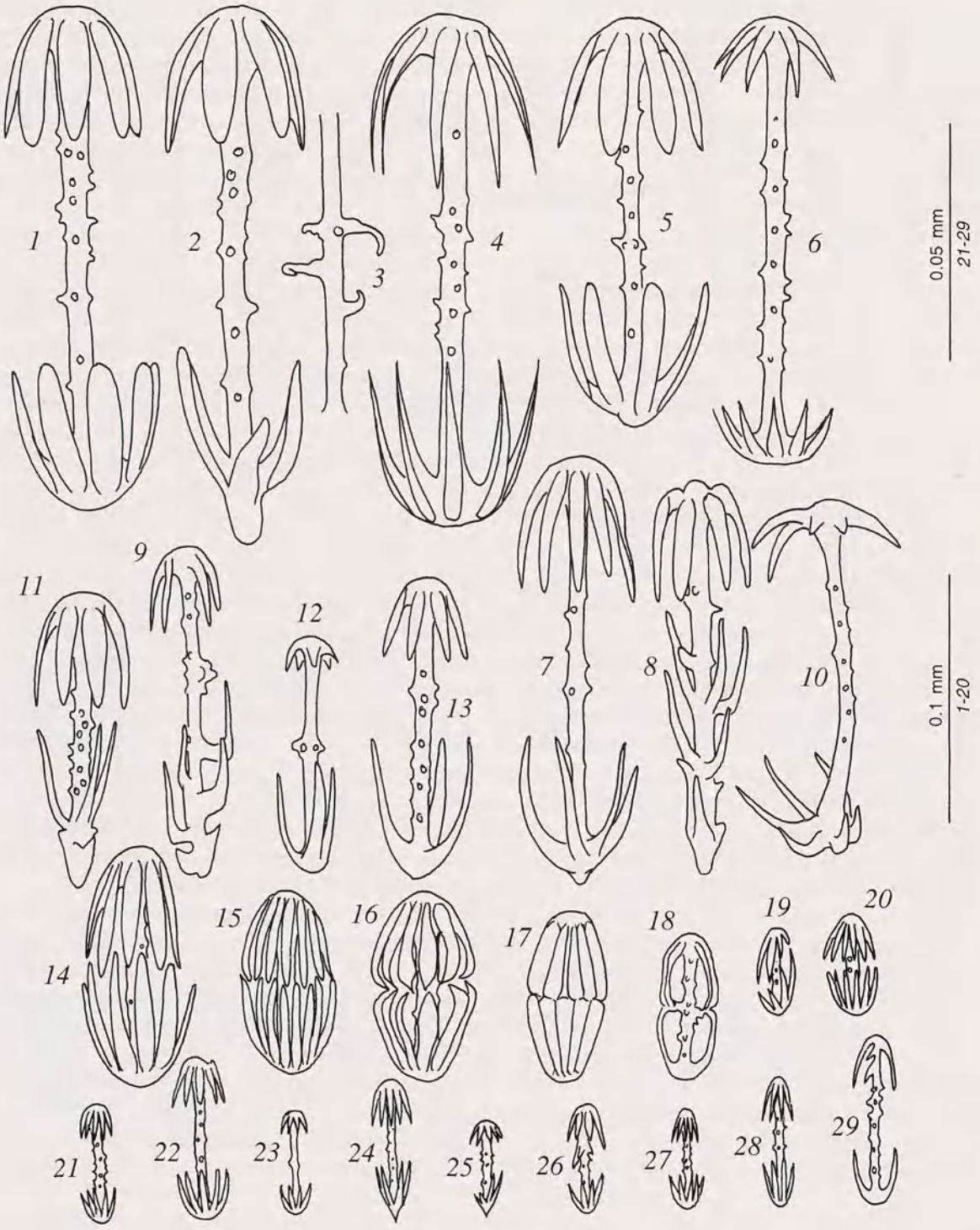

FIG. 63. — Spicules of *Pheronema conicum* Lévi & Lévi, 1982 (types and others specimens): **1-2**, dermal macramphidiscs; **3-13**, atrial macramphidiscs (3, HCL 330; 7, atrial macramphidisc with prolonged shaft; 8-9, atrial macramphidiscs with prolonged shaft and deformed umbel; 9, HCL 340; 10, paradisc, HCL 339; 11, atrial macramphidisc with prolonged shaft and deformed umbel; 12-13, hemidiscs, HCL 339); **14-20**, atrial oval macramphidiscs (14, HCL 322; 15, HCL 323; 17, atrial oval macramphidisc with fused teeth, HCL 322; 18, optical section of atrial oval macramphidisc with fused teeth, HCL 322; 19, atrial oval paradisc, HCL 313; 20, HCL 314); **21-29**, micramphidiscs (21, HCL 322; 24, micramphidisc with prolonged shaft; 25, paradisc with prolonged shaft; 26, HCL 322; 27, hemidisc, HCL 337; 28, HCL 337; 29, HCL 314).

Source : MNHN, Paris

types of these curious forms. Total length of atrial micramphidiscs (fig. 63.21-29) 0.016-0.043 mm, umbel length 0.004-0.013 mm, umbel diameter 0.005-0.012 mm. The micramphidiscs are mostly located in the vicinity of dermal and atrial surfaces. They are usually regular in shape and size but sometimes they display some particular deformations. Sometimes the umbels are different: one is pileate or spherical, whereas the other has a conical tip. Sometimes some of the teeth of an umbel are of different length, so that the spicule is nearly a paradisc. The shafts are usually covered with tubercles or, rarely, they have widening in the middle. Some tubercles of the shafts are long up to the length of the teeth, and have the teeth-like shape of some atrial macramphidiscs.

REMARKS. — Despite the specific forms of newly found amphidiscs, *P. conicum* is close to *P. giganteum* Schulze *(stricto sensu)*. They both have similar uncinates of two types, one of which is small and whip-like, with a rough surface rather than spinous. The microhexactins in both species predominate over other forms. *P. giganteum*, like *P. conicum*, has oval amphidiscs (mesamphidiscs) with teeth meeting at the equator and macramphidiscs with both pileate and spherical umbels. At least some deformations of the macramphidiscs were found in the reexamined holotype of *P. giganteum.*

The description of "polyactin" spicules in some Pheronematidae that resulted from microhexactins that developed extra rays is not usual for the subclass Amphidiscophora. This character belongs to another subclass, Hexasterophora, which has "mainly or all astral microtriaxones" (REID, 1958a). In the Amphidiscophora, "the parenchymal microtriaxones are always holactins, never astral" (REID, 1958a). Does this curious case again bring into doubt the system of subclasses of Hexactinellida? These asterous spicules are very rare, and they have been found among their ancestral forms the "holactines", so it is better to consider them as abnormal forms and to ignore them as a problem of macrotaxonomy. The finding of hemidiscs in *Pheronema conicum* leads to the discussion of the taxonomic status of the order Hemidiscosa (Reid, 1958a), or Hemidiscaria (Schrammen, 1924). REID (1958a) defined this order as "Amphidiscophora with birotulates in the form of hemidiscs; other characters unknown". The hypothesis on the convergent evolution of hemidiscs and amphidiscs (MOSTLER & MEHL, 1990) is true if only the hemidisc of *Pheronema conicum* evolved convergently with "true" hemidiscs of Hemidiscosa. The only reference on the difference between Amphidiscosa (Reid, 1958a), or Amphidiscaria (Schrammen, 1924), and Hemidiscosa is the note that hemidiscs occupy a "different position within the sponge body than the amphidiscs of Recent Amphidiscophora, and thus the hemidiscs might have been also functionally different" (MOSTLER & MEHL, 1991). The definition does not seem to be sufficient enough for a taxon of order rank and requires further study of data on spicule content. To give the order rank for Hemidiscosa it must distinctly differ from that of Amphidiscosa. It is very likely that Hemidiscosa is a lower taxon of the order Amphidiscosa of SCHRAMMEN (1924) since *Pheronema conicum* is clearly a representative of Amphidiscosa.

DISTRIBUTION. — New Caledonia, Loyalty and Chesterfield Islands.

Pheronema giganteum Schulze, 1886

Fig. 64; Tab. 26

Pheronema giganteum Schulze, 1886: 66; 1887: 250, pl. 45-46; 1893: 563. — OKADA, 1932: 6. — IJIMA & OKADA, 1938: 414.
Not *Pheronema giganteum* - IJIMA, 1927: 10.
Not *Pheronema giganteum* - BURTON, 1959: 176 (= *Pheronema pilosum* Lévi, in part).

MATERIAL EXAMINED. — **Indonesia**. *"Challenger"*, stn 192, Little Kai Island, 5°49'15"S, 132°14'15"E, 235 m: NHM 1887.10.20.101.

TYPES. — *Holotype*: NHM 1887.10.20.101 (*"Challenger"*, stn 192, Little Kai Island, 5°49'15"S-132°14'15"E, 235 m).

DESCRIPTION. — The description only supplements that of SCHULZE (1887) since nothing besides the holotype already described was examined.

Source : MNHN, Paris

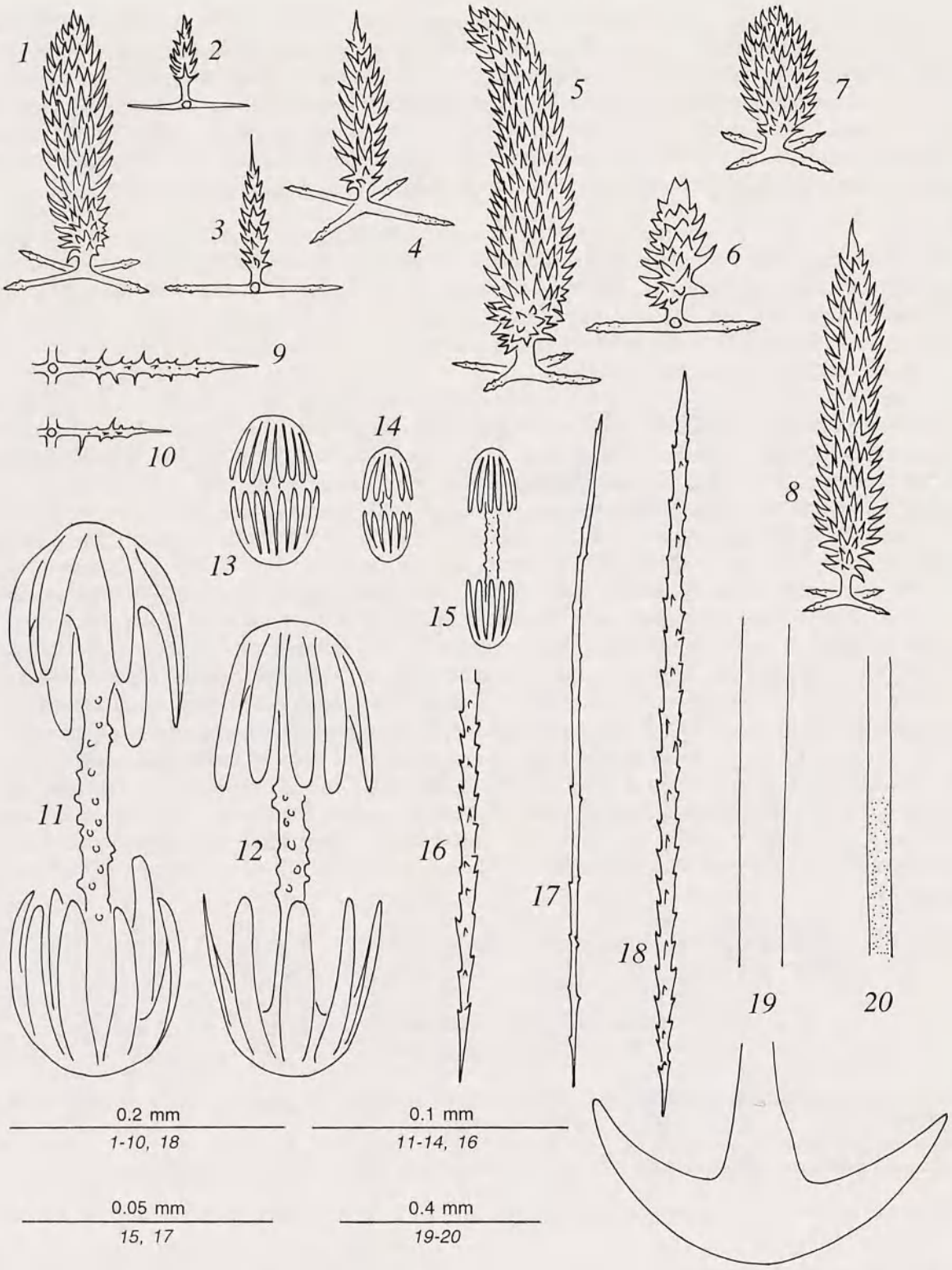

FIG. 64. — Spicules of *Pheronema giganteum* Schulze, 1887 (holotype): **1-4**, dermal pinular pentactins; **5-8**, atrial pinular pentactins; **9-10**, microhexactins; **11-12**, macramphidiscs; **13-14**, oval mesamphidiscs; **15**, micramphidisc; **16**, macruncinate; **17**, whip-like micruncinate; **18**, mesuncinate; **19**, anchorate basalia; **20**, diactin with smooth and rough parts.

Source : MNHN, Paris

Spicules: The uncinates belong to three types. Macruncinates (fig. 64.16) are several mm long and about 0.005-0.010 mm in diameter. Mesuncinates (fig. 64.18) are relatively short, about 0.35-0.72/0.005 mm. Both macruncinate and micruncinate are covered with spines typical for these types of spicules as in other Pheronematidae. Micruncinates (fig. 64.17) (0.13-0.30/0.001 mm) are whip-like. They are covered with very shallow and obtuse spines. Dermal and atrial pinular pentactins (fig. 64.1-8) are similar. The pinular ray is oval or whip-like in shape, rarely slightly curved. The outer end is usually sharply pointed or conical. It can project far beyond the last spines or more often be equal in length to the last spines. The lower spines sometimes branch into two spines. The pinular ray of dermal pentactin is 0.068-0.334/0.004-0.040 mm, of atrial one 0.076-0.266/0.004-0.040 mm. The tangential rays are often smooth near the base and on the first half of the ray, whereas the second half is rough or covered with spines. The tangential ray of dermal pentactin is 0.030-0.084/0.004, of atrial one 0.038-0.068/0.004 mm.

Microhexactins (fig. 64.9-10) and micropentactins have rays (0.061-0.152/0.005-0.012 mm) covered with spines. Amphidiscs are divided into three classes. The macramphidiscs (fig. 64.11-12) often have teeth of different length, spherical umbels and tuberculated shafts. Total length of macramphidisc is 0.167-0.289 mm, the umbel length 0.068-0.084 mm, the umbel diameter 0.053-0.084 mm. The mesamphidiscs (fig. 64.13-14) are oval with teeth that nearly meet at the equator. All were found among the atrial spicules. Total length of mesamphidisc is 0.032-0.054 mm, the umbel length 0.016-0.027 mm, the umbel diameter 0.016-0.032 mm. Micramphidiscs (fig. 64.15) have spiny or tuberculated shafts. Total length of mesamphidisc is 0.023-0.041 mm, the umbel length 0.007-0.018 mm, the umbel diameter 0.005-0.012 mm.

REMARKS. — In most of the features mentioned above *P. giganteum* is closer to *P. conicum* than to *P. giganteum* described by IJIMA (1927). Both *P. giganteum* and *P. conicum* have deformations of amphidiscs, the former has some deformations not so "deep" as the latter. These abnormal amphidiscs were not described by SCHULZE (1887) despite that they prevail over "normal" ones. The uncinate composition, sizes of microhexactins and micro-pentactins of *P. giganteum* of SCHULZE are similar to *P. conicum* rather than to *P. giganteum* of IJIMA. These facts distinguish the latter as a separate species. The status of the other specimens of *P. giganteum* described in the literature is not clear. The specimen described by IJIMA and OKADA (1938) is likely to be *P. giganteum.* The specimen described by OKADA (1932) is less clear because of its poor description. The reexamination of the specimen described by BURTON (1959) leads to transfer it to *P. pilosum.* As for the specimen described by IJIMA (1927), it seems better to refer it to a new species. Some specimens from the eastern and western Indian Ocean likely belong to *P. giganteum*, but probably to a new subspecies. They have no mesamphidiscs and sometimes no macramphidiscs (unpublished material).

DISTRIBUTION. — Indonesia, Japan.

Pheronema pseudogiganteum sp. nov.

Fig. 65; Tab. 27

Pheronema giganteum Ijima, 1927: 10, pl. 5 fig. 1-7. (Non Schulze, 1886).

MATERIAL EXAMINED. — *"Siboga"*: stn 251, 5°28.4'S, 132°00.2'E, 204 m: PQR 5099 (ZMA). Identified as *P. giganteum* by IJIMA, 1927.

TYPES. — *Holotype*: PQR 5099 (*"Siboga"*, stn 251, 5°28.4'S, 132°00.2'E, 204 m) (ZMA).

REMARKS. — The following notes on spicules complete the excellent description of IJIMA (1927). The micruncinates (fig. 65.8-9) are short, usually with a widening in the middle. They are covered with minute spines. Microhexactins (fig. 65.1-4) prevail over analogous micropentactins and other derivatives. Microhexactins have rays of different length which carry spines of different length. Some rays in the microhexactins are reduced up to the spherical outer ends, covered with numerous spines (nearly pinular). Such outer ends are characteristic of one end of the micromonactins, whereas the other is sharply pointed. These micromonactins are rare. Two kinds of

Source : MNHN, Paris

amphidiscs are present. The macramphidiscs (fig. 65.10) have umbels that are regular in shape, with teeth equal in length. The shafts are tuberculated. The micramphidiscs (fig. 65.11) are similar in shape to the macramphidiscs.

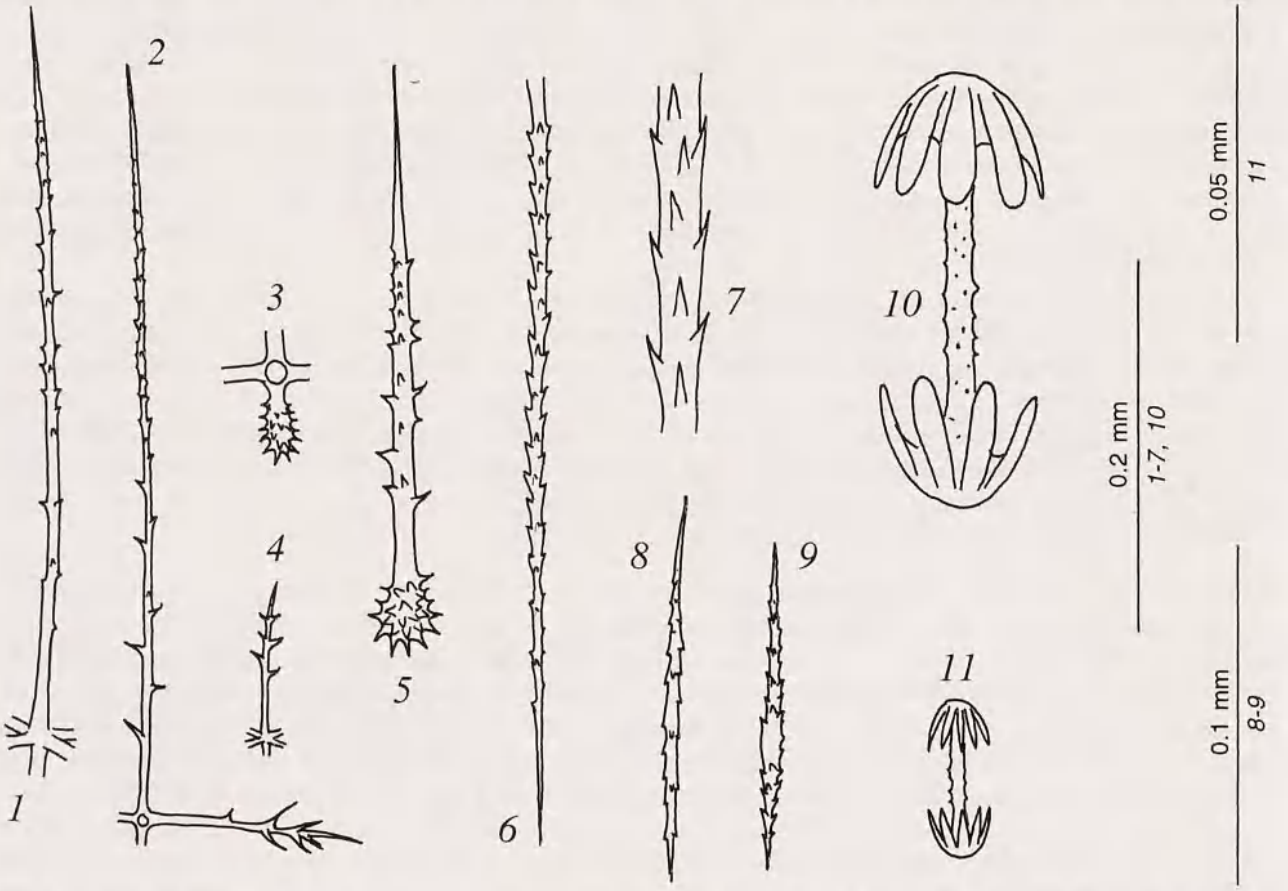

FIG. 65. — Spicules of *Pheronema pseudogiganteum* nov. sp. (holotype): **1-4**, microhexactins; **5**, micromonactin; **6**, mesuncinate; **7**, macruncinate; **8-9**, micruncinates; **10**, macramphidisc; **11**, micramphidisc.

The reasons for distinguishing a new species *P. pseudogiganteum* were given by the revision of the holotype. IJIMA did not revise the holotype, which was described insufficiently (SCHULZE, 1887). The features specific for *P. pseudogiganteum* are regular macramphidiscs, absence of mesamphidiscs, size and shape of micruncinates and microhexactins. Stronger similarities were found between *P. giganteum* and *P. conicum* on one hand and *P. pseudogiganteum* of IJIMA and its forma from the New Caledonian area described below on the other hand.

ETYMOLOGY. — This specific name alludes to the differences with *Pheronema giganteum*.

Pheronema pseudogiganteum forma ***nuda*** nov.

Fig. 66-67, 70; Tab. 28

MATERIAL EXAMINED. — **New Caledonia**. BIOCAL: stn DW 51, 23°05.43'S, 167°45.35'E, 700-680 m, 31.08.1985: HCL 360. — Stn CP 52, 23°06.18'S, 167°47.07'E, 600-540 m, 31.08.1985: HCL 358-359.

DESCRIPTION. — The sponge is ovoid, with a deep atrial cavity. The specimen HCL 358 is 70 mm in length, 45 mm in diameter. The osculum is 20 mm in maximal diameter. The walls are about 10 mm thick. Prostalia are represented by basalia only. Basalia are about 30 mm long. The specimen HCL 359 is 100 mm in length, 30 mm in diameter. The specimen HCL 360 is a fragment.

Source : MNHN, Paris

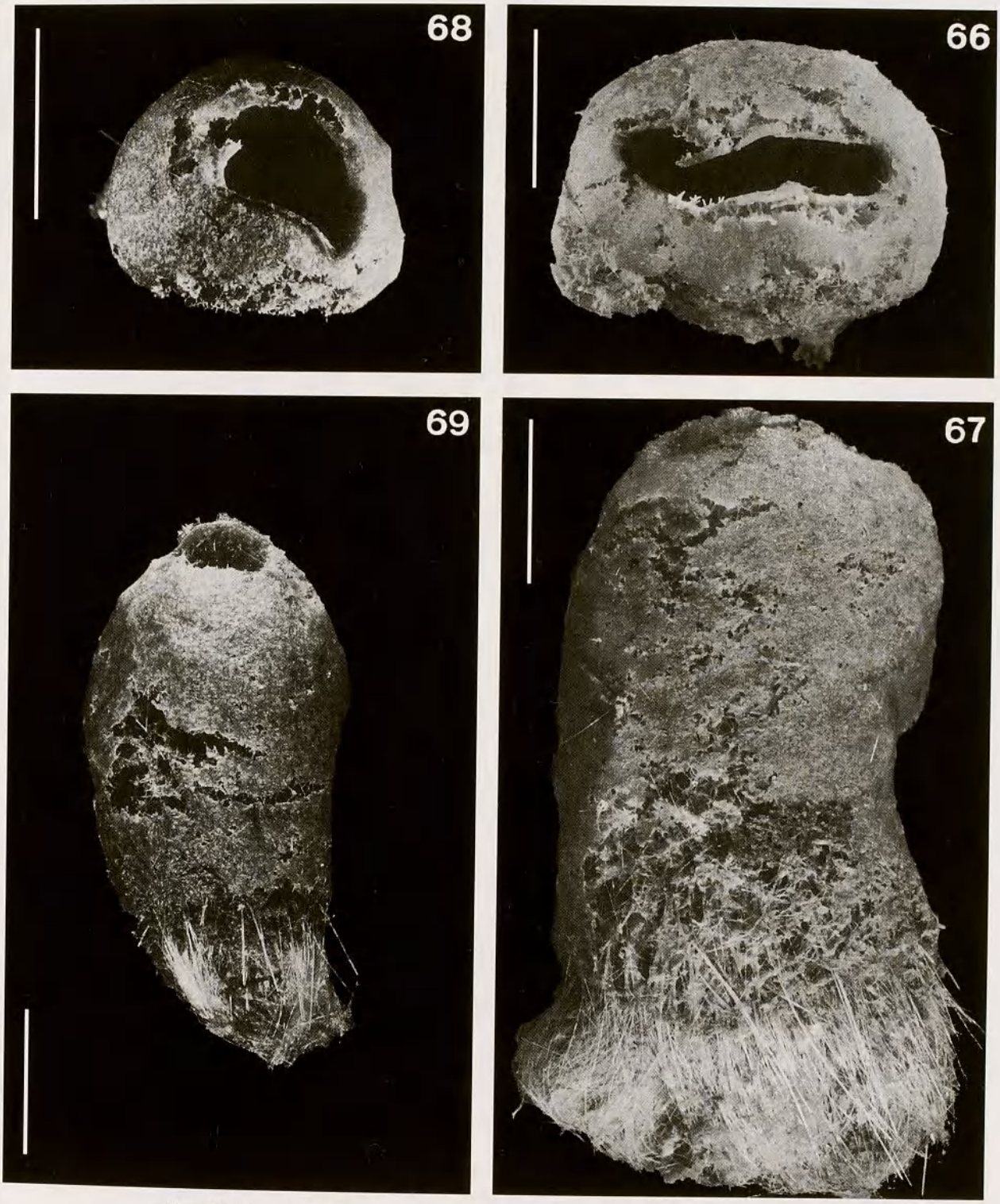

FIG. 66-67. — *Pheronema pseudogiganteum* f. *nuda* (HCL 358). Scales = 2 cm.
FIG. 68-69. — *Pheronema pseudogiganteum* f. *vaubana*. (HCL 353). Scales = 2 cm.

Spicules: The choanosomal skeleton consists of pentactins and sparse stauractins, with rays 0.014-0.100 mm in diameter. Three types of uncinates are known. Macruncinates (fig. 70.16) are several mm in length and

Source : MNHN, Paris

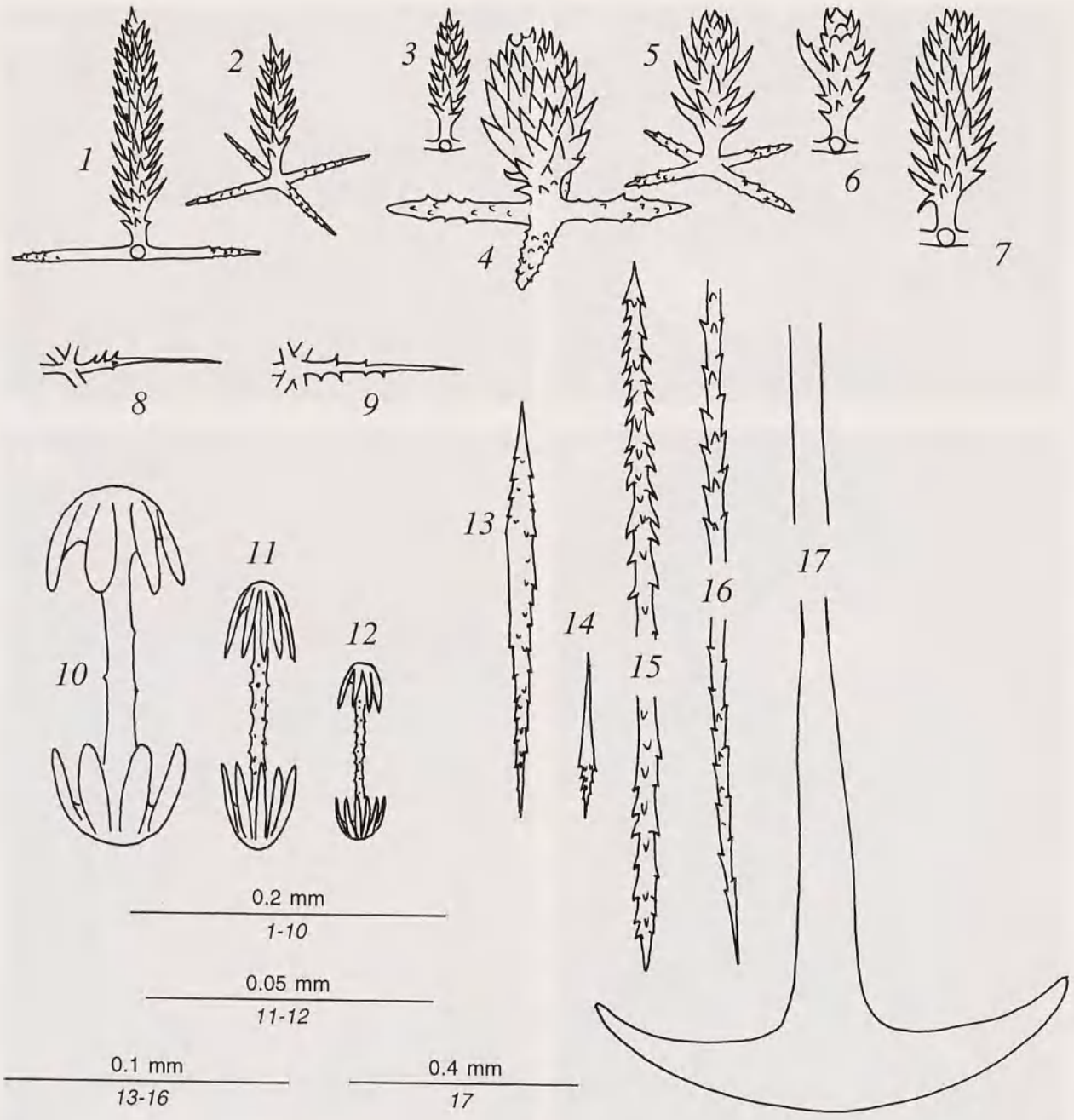

FIG. 70. — *Pheronema pseudogiganteum* f. *nuda* (HCL 358): **1-2**, dermal pinular pentactins; **3-7**, atrial pinular pentactins; **8**, micropentactin; **9**, microhexactin; **10**, macramphidiscs; **11-12**, micramphidiscs; **13-14**, micruncinates; **15**, mesuncinate; **16**, macruncinate; **17**, anchorate basalia.

0.008 mm in diameter. The mesuncinates (fig. 70.15) are about 0.45-0.52/0.004-0.009 mm. They are both covered with spines. The micruncinates (fig. 70.13-14) are spindle-like, 0.041-0.117/0.004-0.007 mm, entirely or partly serrated. The basalia are anchorate spicules with smooth rachis. Dermalia are pinular pentactins (fig. 70.1-7) with the pinular ray rather thin, 0.061-0.220/0.009-0.015 mm. The outer ends are finely pointed and project not far beyond the last spines. The tangential rays of dermal pentactins 0.046-0.152/0.005-0.007 mm are usually smooth at the base and covered with spines near the ends of the rays. Atrialia are pinular pentactins. The pinular ray (0.084-0.144/0.007-0.037 mm) varies in shape; sometimes it is similar to that of dermal pentactins but

Source : MNHN, Paris

usually it is rather thick and has more or less distinct oval shape. The outer ends are longer or equal or smaller than the last spines. The tangential rays (0.030-0.091/0.004-0.011 mm) are usually covered with spines. Pinular hexactins are sparse dermal and atrial spicules.

The microhexactins and micropentactins (fig. 70.8-9) have rays (0.046-0.213/0.004-0.011 mm) covered with spines. Amphidiscs are divided into two types. Umbels of macramphidiscs (fig. 70.10) are regular in shape, shafts smooth, usually straight or rarely with widenings. Total length of macramphidiscs 0.152-0.236 mm, the umbel length 0.053-0.084 mm, the umbel diameter 0.061-0.099 mm. Shafts of micramphidiscs (fig. 70.11-12) are covered with spines. Total length of micramphidiscs 0.027-0.049 mm, umbel length 0.008-0.016 mm, umbel diameter 0.007-0.013 mm.

ETYMOLOGY. — The forma name refers to the absence of prostalia except basalia.

Pheronema pseudogiganteum forma *vaubana* nov.

Fig. 68-69, 71; Tab. 29

MATERIAL EXAMINED. — **New Caledonia**. MUSORSTOM 4: stn CP 217, 22°03.60'S, 167°27.00'E, 850 m, 29.09.1985: HCL 363.

DESCRIPTION. — The sponge is ovoid, 55 mm long, 25 x 35 mm in diameter. The atrial cavity is deep, the walls are about 5 mm in thickness. The sponge has two longitudinal rows on the dermal surface that extend from the base to the osculum. They are the result of growth rather than a character of the subspecies. Prostalia oscularia are about 3 mm long, they edge the osculum regularly. Basalia are a broad tuft with same diameter as the lower part of the sponge. They are about 15-20 mm long.

Spicules: The choanosomal spicules are pentactins with rays 0.05-0.11 mm in diameter. The uncinates demonstrate three varieties. Macruncinates (fig. 71.10) are several mm long and 0.005-0.010 mm in diameter. The mesuncinates (fig. 71.11) are about 0.70-1.00/0.001-0.002 mm. They are both covered with spines. The micruncinates (fig. 71.12-18) are 0.038-0.182/0.004-0.010 mm, spindle-like and partly serrated. Prostalia oscularia are sceptres (fig. 71.8) 3-5/0.02 mm. Basalia are anchorate spicules (fig. 71.9) with smooth rachis. Dermalia are pinular pentactins (fig. 71.1-5) with pinular ray 0.068-0.114/0.007-0.010 mm slightly widening. Its outer end is sharply pointed and projects not far from the ends of the last spines. The pinular ray of the atrial pentactins 0.084-0.122/0.005-0.020 mm is similar to that of dermal ones, sometimes it is curved or oval in shape. If oval, the outer end is equal in length with the last spines. Tangential rays both of dermalia and atrialia are covered with spines. Tangential rays of the dermal pentactins are 0.046-0.084/0.005 mm, of the atrial ones 0.038-0.114/0.005-0.007 mm.

Microhexactins (fig. 71.6-7) and micropentactins have rays (0.076-0.167/0.004 mm) covered with spines. Two types of amphidiscs can be distinguished. Macramphidiscs (fig. 71.19-20) have umbels that are regular in shape and have smooth shafts, sometimes they have some widenings. Total length of macramphidiscs 0.167-0.251 mm, length of umbel 0.053-0.076 mm, umbel diameter 0.068-0.106 mm. The micramphidiscs (fig. 71.21-22) are elongated, the shafts covered with spines. Total length of micramphidiscs 0.029-0.058 mm, length of umbel 0.007-0.018 mm, umbel diameter 0.007-0.013 mm.

ETYMOLOGY. — Named after the *"Vauban"*, which has been used in many research cruises in New Caledonia and the Coral Sea.

Pheronema pseudogiganteum forma *stellata* nov.

Fig. 72; Tab. 30

MATERIAL EXAMINED. — **Loyalty Islands**. BIOGEOCAL: stn CP 290, 20°36.91'S, 167°03.34'E, 920-760 m, 27.04.1987: HCL 355-357, 473-479.

Source : MNHN, Paris

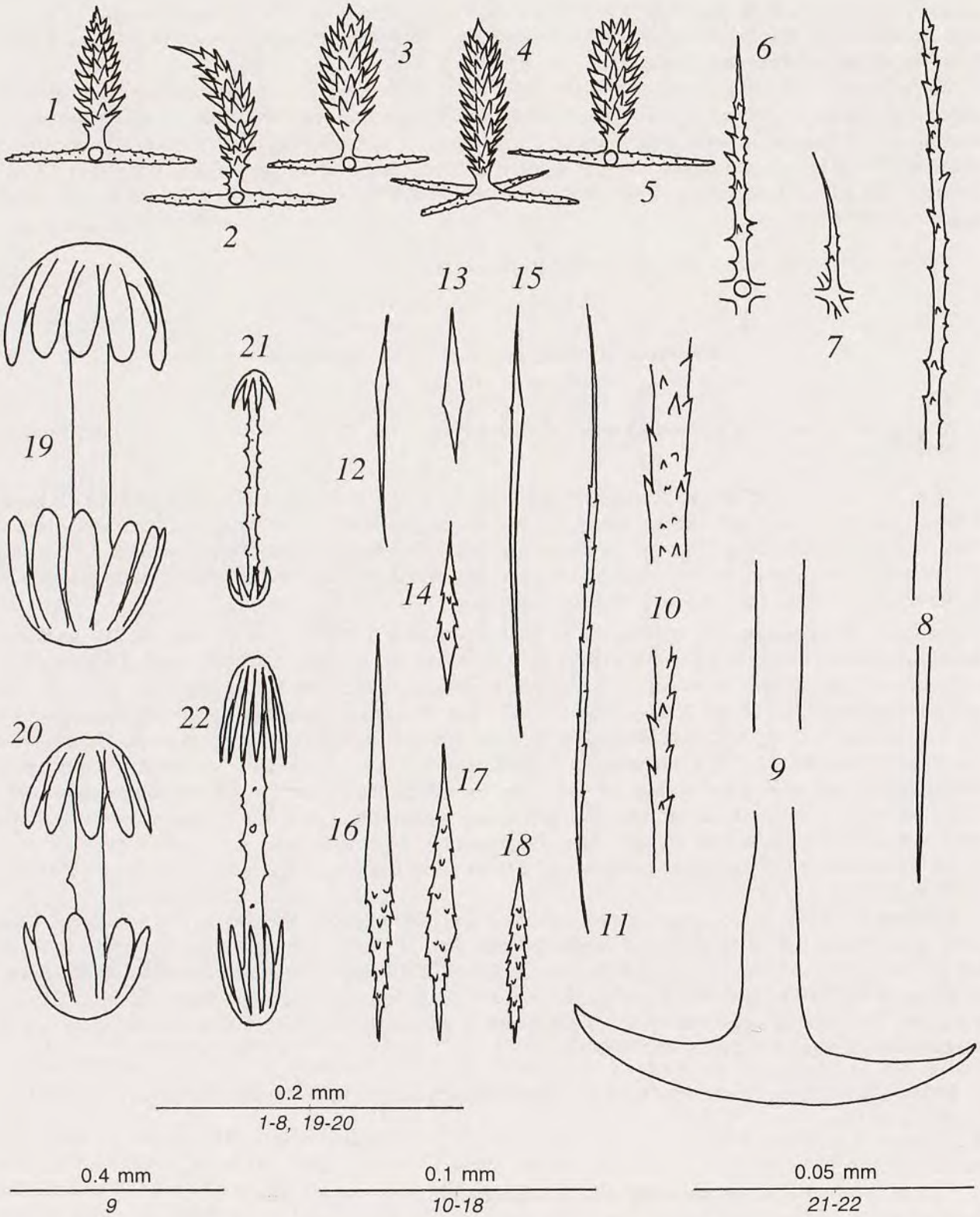

FIG. 71. — Spicules of *Pheronema pseudogiganteum* f. *vaubana* (HCL 353): **1**, dermal pinular pentactin; **2-5**, atrial pinular pentactins; **6-7**, microhexactins; **8**, sceptre; **9**, anchorate basalia; **10**, macruncinate; **11**, mesuncinate; **12-18**, micruncinates; **19-20**, macramphidiscs; **21-22**, micramphidiscs.

Source : MNHN, Paris

DESCRIPTION. — This sponge is represented by different fragments. Since they were collected from the same station, these fragments must belong either to a single or numerous specimens. In the first case, the observed variability of spicules results from the different location of fragments in the sponge, in the other, from fragments from separate specimens. Most fragments are parts of the 5-10 mm thick walls. The fragment assigned as holotype is 7-8 mm thick. The other fragments are parts of dermalia and subdermalia with tufts of basalia.

Spicules: The choanosomal skeleton consists of pentactins with rays 0.002-0.004 mm in diameter. Macruncinates (fig. 72.5) are several mm long and 0.01 mm in diameter. The mesuncinates (fig. 72.6) are about 0.3/0.002 mm. Both macruncinates and mesuncinates are covered with spines. The micruncinates (fig. 72.7-8) 0.041-0.118/0.004-0.008 mm appear smooth or slightly serrated. The basalia are anchorate spicules (fig. 72.4) with smooth rachis. Dermalia and atrialia are pinular pentactins (fig. 72.1-3) similar in shape. The pinular ray is rather thin, finely pointed with the outer end that does not project far beyond the last spines. The pinular ray of dermal pentactin is 0.042-0.198/0.007-0.020 mm, of the atrial one 0.087-0.555/0.010-0.026 mm. The tangential rays are smooth, with outer ends covered with spines. The tangential rays of dermal pentactin are 0.034-0.106/0.006 mm, of the atrial ones 0.038-0.144/0.006 mm.

Microhexactins (fig. 72.16-21) with thick rays 0.046-0.198/0.011-0.015 mm, prevail on the other types of analogous spicules: micropentactins, microstauractins, and spicules with more than six rays. These microscleres have rays usually covered with spines, seldom smooth. They are conically pointed or rarely have a rounded end. The other spicules presented by microhexactins only have thin rays about 0.004 mm in diameter and covered with spines. Ray length is equal to that of thick-rayed forms. The thin-rayed forms are sparse. Amphidiscs can be divided into three types. Macramphidiscs (fig. 72.9-10) have umbels regular in shape, shafts are smooth. Total length of macramphidiscs 0.152-0.228 mm, umbel length 0.042-0.068 mm, umbel diameter 0.068-0.118 mm. Mesamphidiscs (fig. 72.11-13) and micramphidiscs (fig. 72.14-15) are similar in shape and size. Their shafts are covered with numerous spines. Total length of mesamphidiscs 0.034-0.092 mm, umbel length 0.013-0.034 mm, umbel diameter 0.012-0.030 mm. Total length of micramphidiscs 0.020-0.043 mm, umbel length 0.005-0.018 mm, umbel diameter 0.005-0.014 mm.

ETYMOLOGY. — The forma name refers to the shape of microhexactin spicules.

Pheronema pseudogiganteum forma ***variodisca*** nov.

Fig. 73; Tab. 31

MATERIAL EXAMINED. — **New Caledonia**. BIOCAL: stn CP 54, 23°10.30'S, 167°42'E, 1000-950 m, 1.09.1985: HCL 364.

DESCRIPTION. — The sponge is ovoid, 55 mm long, 40 mm in diameter. The osculum is 20 mm in diameter, the atrial cavity is about 20 mm long.

Spicules: The choanosomal spicules are pentactins with rays 0.04-0.08 mm in diameter. The uncinates are of three types. Macruncinates (fig. 73.10) are several mm long and 0.005 mm in diameter. The mesuncinates (fig. 73.11-13) are about 0.70-1.00/0.004-0.010 mm. They are both covered with spines. The micruncinates (fig. 73.14) 0.030-0.084/0.004 mm are spindle-like, and appear smooth under light microscope. Dermalia are pinular pentactins (fig. 73.1-6) and sparse hexactins with pinular ray (0.068-0.137/0.004-0.012 mm) sharply pointed with the outer end that projects freely beyond the last spines. Pinular ray in the atrial pentactins 0.091-0.160/0.004-0.030 mm. Pinular ray of atrial pentactin is similar to that of the dermal ones or is rather ovoid in shape, with the end terminating at the ends of last spines. The tangential rays are covered with spines in both dermal and atrial pinular spicules. The tangential ray of the dermal pentactin is 0.042-0.080/0.002-0.007 mm, of the atrial pentactin 0.049-0.114/0.006-0.010 mm.

The microhexactins and micropentactins (fig. 73.7-8), with rays 0.057-0.129/0.004 mm, are covered with spines. Macramphidiscs (fig. 73.15-20) have umbels and teeth of various shapes. The "normal" macramphidiscs have identical umbels and oval or sometimes thin hook-like teeth. Umbels of some macramphidiscs have a different number of teeth (4-8) in each umbel. Umbels of other amphidiscs differ in diameter because the teeth of

Source : MNHN, Paris

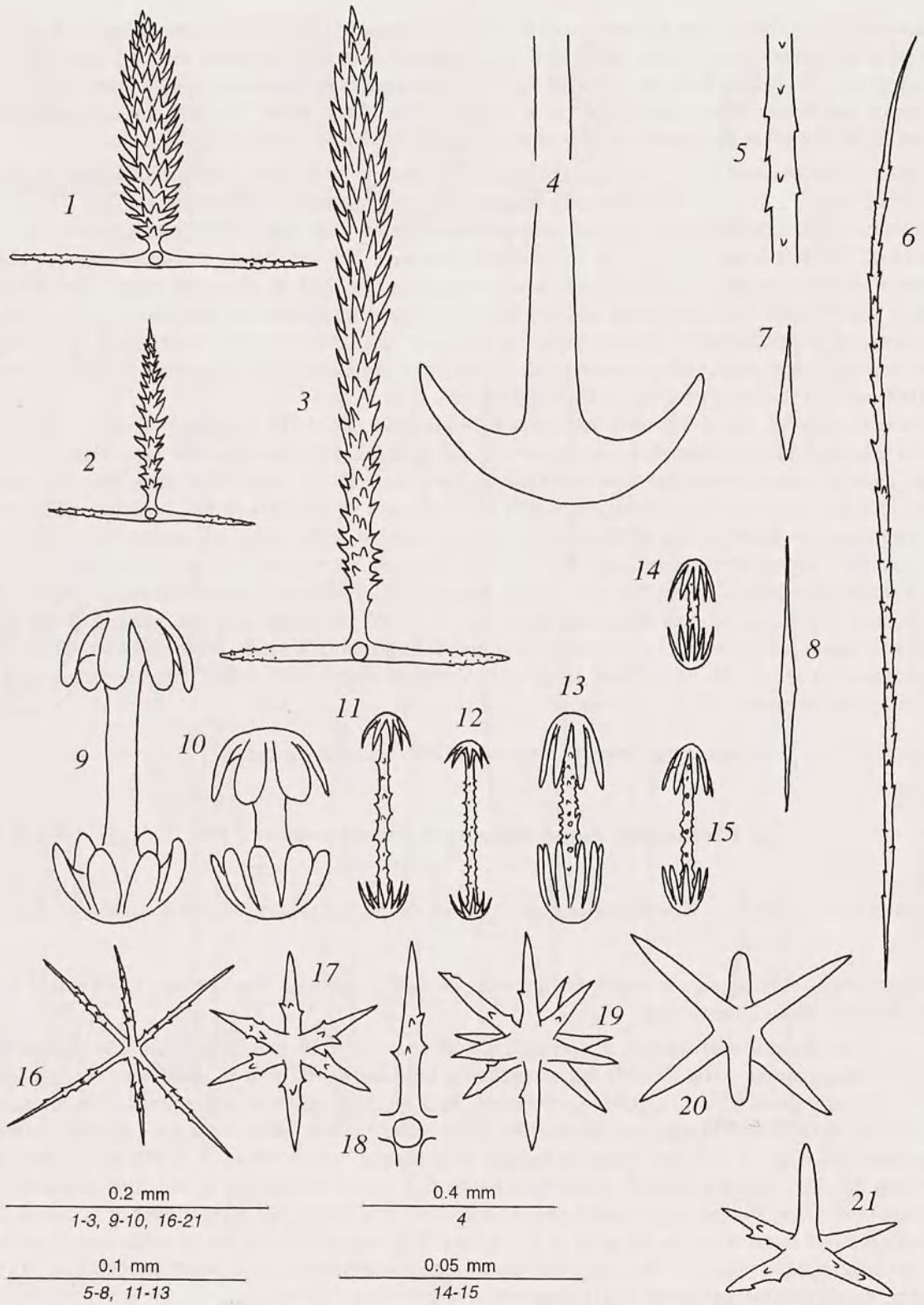

FIG. 72. — Spicules of *Pheronema pseudogiganteum* f. *stellata*: **1-2**, dermal pinular pentactins (1, HCL 355; 2, HCL 476); **3**, atrial pinular pentactin (HCL 355); **4**, anchorate basalia (HCL 357); **5**, macruncinate (HCL 355); **6**, mesuncinate (HCL 355); **7-8**, micruncinate (HCL 355); **9-10**, macramphidiscs (9, HCL 478; 10, HCL 357); **11-13** mesamphidisc (11-12, HCL 475; 13, HCL 478); **14-15**, micramphidiscs (HCL 478); **16-21**, microhexactins (16-19, HCL 478; 20, HCL 356; 21, HCL 478).

Source : MNHN, Paris

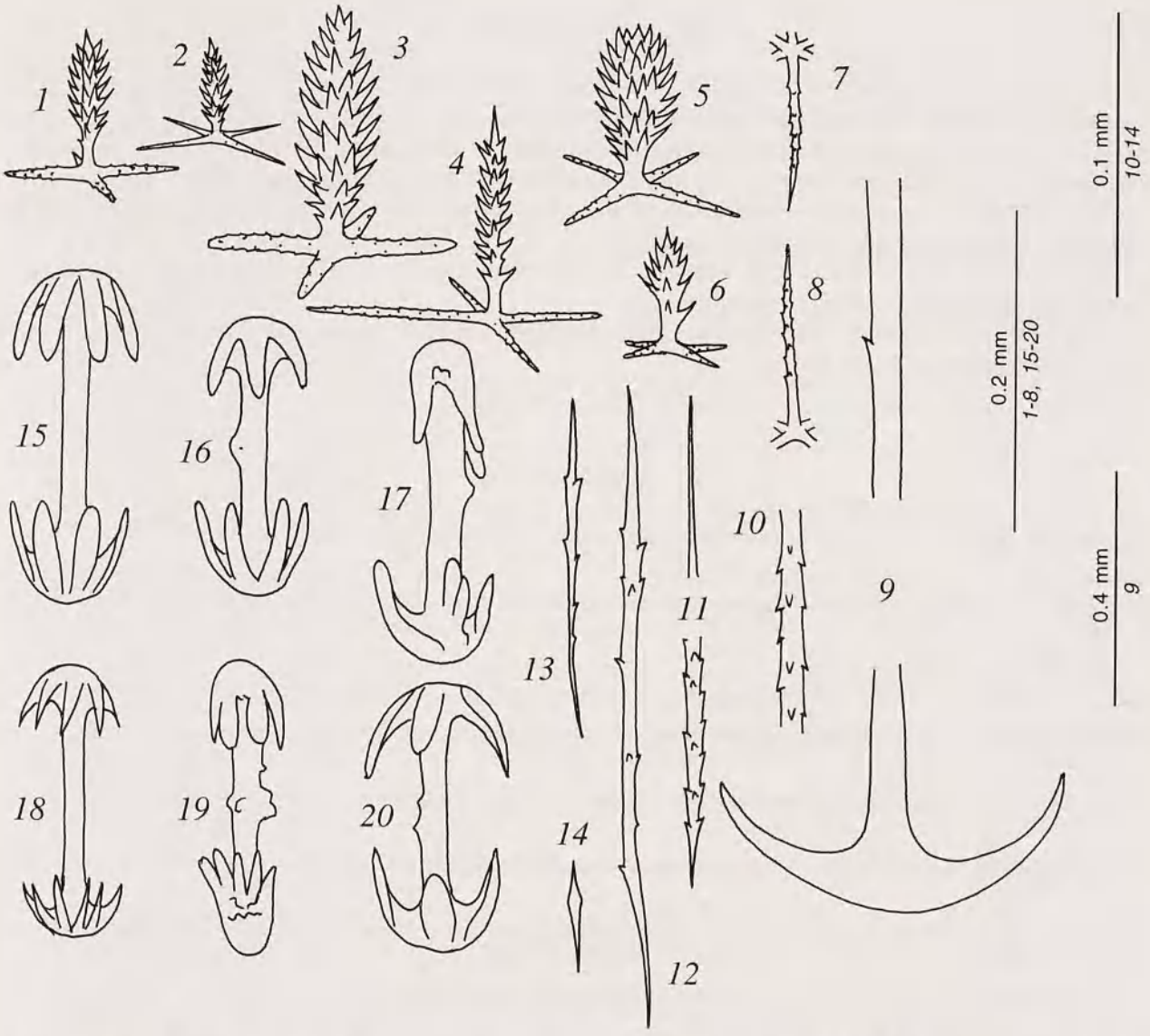

FIG. 73. — Spicules of *Pheronema pseudogiganteum* f. *variodisca* (HCL 364): **1-2**, dermal pinular pentactins; **3-6**, atrial pinular pentactins; **7**, microhexactin; **8**, micropentactin; **9**, anchorate basalia; **10**, macruncinate; **11-13**, mesuncinates; **14**, micruncinate; **15-20**, amphidiscs.

the umbel are closer to the shaft, which makes the umbel smaller. The shafts are smooth but sometimes with widenings or tubercles. Total length of macramphidiscs 0.137-0.228 mm, umbels length 0.046-0.076 mm, umbels diameter 0.053-0.091 mm. Only two micramphidiscs were found in a microscopic preparation. They probably belonged to another specimen.

ETYMOLOGY. — The forma name refers to the abnormal umbels of some amphidiscs.

REMARKS. — All these specimens belong to *Pheronema pseudogiganteum* sp. nov. It is possible that the variation of shape and size of dermal and atrial pinular pentactins, of microhexactins and its derivatives, together with the combination and shape of amphidiscs will be good features for a future taxonomic subspecific definition. But these features are mosaically expressed in the different specimens.

Source : MNHN, Paris

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Source : MNHN, Paris

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Source : MNHN, Paris

ANNEXE

MENSURATIONS OF SPICULES

In all the tables : L = length; D = diameter. All measurements in mm.

TABLE 1. — Some measurements of the spicules of *Hyalonema (Leptonema) spatha.*

	HCL 413					HCL 414					HCL 415				
	n	avg	min	max	std	n	avg	min	max	std	n	avg	min	max	std
L dermal pentactin pinular ray	25	.190	.120	.280	.039	25	.272	.180	.380	.047	15	.113	.089	.126	.011
L dermal pentactin tangential ray	24	.038	.030	.050	.006	25	.046	.032	.060	.006	13	.029	.022	.037	.005
L atrial pentactin pinular ray	25	.147	.080	.210	.036	18	.182	.100	.270	.052	15	.124	.074	.178	.025
L atrial pentactin tangential ray	25	.034	.025	.045	.006	18	.039	.030	.050	.005	15	.028	.022	.037	.004
L macramphidisc	19	.046	.025	.098	.019	25	.063	.029	.090	.017	8	.068	.041	.093	.017
L macramphidisc umbel	19	.017	.008	.033	.007	25	.023	.010	.038	.007	8	.025	.019	.030	.005
D macramphidisc umbel	19	.015	.008	.028	.005	25	.018	.010	.028	.005	.8	.018	.013	.022	.003
L micramphidisc	25	.021	.018	.025	.002	25	.022	.018	.028	.002	15	.018	.016	.023	.002
L micramphidisc umbel	25	.007	.005	.008	.001	25	.007	.005	.008	.001	25	.007	.005	.008	.001
D micramphidisc umbel	25	.007	.005	.009	.001	25	.007	.006	.009	.001	15	.006	.005	.007	.001
L stauractin long ray	25	.090	.068	.115	.012	25	.110	.085	.145	.014	10	.090	.074	.115	.017
L stauractin short ray	25	.014	.010	.018	.002	25	.015	.008	.025	.004	10	.016	.011	.022	.003
	HCL 495					HCL 416					HCL 417				
L dermal pentactin pinular ray	15	.182	.085	.255	.044	15	.286	.152	.363	.060	15	.140	.085	.170	.025
L dermal pentactin tangential ray	15	.032	.022	.041	.005	15	.037	.030	.044	.004	15	.028	.019	.037	.005
L atrial pentactin pinular ray	15	.179	.100	.211	.028	15	.189	.144	.244	.033	15	.130	.107	.207	.025
L atrial pentactin tangential ray	15	.032	.026	.041	.005	15	.031	.022	.041	.005	15	.029	.019	.037	.006
L macramphidisc	22	.086	.043	.149	.033	20	.085	.041	.107	.017	15	.073	.037	107	.022
L macramphidisc umbel	22	.032	.015	.063	.014	20	.017	.011	.022	.003	15	.030	.015	.048	.010
D macramphidisc umbel	22	.025	.013	.044	.009	20	.025	.010	.059	.011	15	.022	.013	.031	.006
L micramphidisc	15	.025	.017	.041	.005	15	.021	.020	.023	.001	15	.019	.014	.029	.004
L micramphidisc umbel	15	.007	.004	.015	.002	15	.005	.004	.006	.001	15	.006	.004	.013	.002
D micramphidisc umbel	15	.008	.006	.013	.002	15	.006	.005	.007	.001	15	.006	.005	.010	.001
L stauractin long ray	15	.114	.096	.133	.012	15	.092	.070	.107	.011	15	.095	.081	.111	.010
L stauractin short ray	15	.016	.011	.022	.003	15	.017	.015	.022	.002	15	.015	.011	.022	.004
	HCL 418					HCL 419									
L dermal pentactin pinular ray	15	.197	.130	.285	.039	15	.196	.144	.241	.029					
L dermal pentactin tangential ray	15	.032	.019	.041	.007	15	.030	.026	.044	.005					
L atrial pentactin pinular ray	15	.180	.133	.226	.028	15	.179	.137	.248	.028					
L atrial pentactin tangential ray	15	.029	.022	.048	.007	15	.031	.026	.037	.004					
L macramphidisc	15	.081	.041	.100	.017	15	.101	.052	.137	.027					
L macramphidisc umbel	15	.030	.015	.041	.007	15	.038	.019	.056	.011					
D macramphidisc umbel	15	.023	.012	.033	.006	15	.029	.015	.044	.008					
L micramphidisc	15	.022	.014	.032	.005	15	.020	.016	.032	.004					
L micramphidisc umbel	15	.007	.005	.011	.002	15	.006	.004	.011	.002					
D micramphidisc umbel	15	.007	.005	.010	.001	15	.006	.005	.011	.001					
L stauractin long ray	15	.070	.044	.089	.013	15	.104	.089	.118	.009					
L stauractin short ray	15	.017	.011	.026	.003	15	.015	.011	.024	.004					

TABLE 2. — Some measurements of the spicules of *Hyalonema (Onconema) uncinata.*

	HCL 424					HCL 423				
	n	avg	min	max	std	n	avg	min	max	std
L dermal pentactin pinular ray	15	.105	.076	.137	.021					
L dermal penctatin tangential ray	15	.051	.030	.091	.017					
L atrial pentactin pinular ray	15	.154	.129	.167	.011	15	.152	.137	.167	.009
L atrial pentactin tangential ray	15	.028	.023	.034	.004	15	.026	.019	.034	.005
L acanthophore pentactin ray	15	.100	.084	.122	.010					
L microhexactin ray	15	.037	.029	.041	.004	15	.037	.023	.065	.010
L macramphidisc	16	.296	.251	.327	.028	15	.290	.236	.334	.029
L macramphidisc umbel	16	.101	.084	.114	.009	15	.105	.084	.122	.012
D macramphidisc umbel	16	.085	.068	.099	.008	15	.078	.061	.091	.007
L micramphidisc	15	.020	.016	.032	.004	15	.018	.014	.023	.003
L micramphidisc umbel	15	.006	.004	.011	.002	15	.006	.005	.008	.001
D micramphidisc umbel	15	.006	.005	.007	.001	15	.005	.005	.006	.000

Source : MNHN, Paris

TABLE 3. — Some measurements of the spicules of the subgenus *Onconema*. From VON LENDENFELD, 1915.

	H. uncinata		*H. obtusum*		*H. agassizi*	
	min.	max.	min.	max.	min.	max.
L dermal pentactin pinular ray	.0176	.137	.137	.165	.070	.114
L dermal pentactin tangential ray	.030	.091	.010	.050	.018	.043
L atrial pentactin pinular ray	.129	.167	.073	.145	.069	.153
L atrial pentactin tangential ray	.019	.034	.035	.090	.020	.085
L dermal pentactin with equal rays	.084	.122			.025	.080
L microhexactin ray	.023	.065	.021	.040	.025	.080
L macramphidisc	.236	.334	.086	.335	.048	.290
L macramphidisc umbel	.084	.122	.032	.100	.010	.080
D macramphidisc umbel	.061	.099	.016	.112	.010	.086
L micramphidisc	.014	.032	.012	.068	.013	.069
L micramphidisc umbel	.004	.011	.005	.025	.004	.023
D micramphidisc umbel	.005	.007	.004	.026	.005	.014

TABLE 4. — Some measurements of the spicules of *Hyalonema (Pteronema) topsenti*.

	HCL 425					HCL 426					HCL 428				
	n	avg	min	max	std	n	avg	min	max	std	n	avg	min	max	std
L dermal pentactin pinular ray	25	.129	.106	.167	.013	25	.119	.068	.144	.017	12	.161	.091	.198	.030
L dermal pentactin tangential ray	25	.046	.030	.057	.007	25	.045	.023	.061	.008	12	.055	.038	.068	.010
L atrial pentactin pinular ray	25	.257	.053	.403	.110										
L atrial pentactin tangential ray	25	.041	.023	.061	.009										
L microstauractin-pentactin ray	25	.097	.049	.122	.020	25	.109	.068	.160	.021	14	.108	.079	.148	.021
L macramphidisc	25	.336	.266	.403	.031	25	.406	.334	.517	.043	3	.466	.441	.517	.044
L macramphidisc umbel	25	.090	.076	.106	.009	25	.112	.091	.129	.012	3	.129	.122	.144	.013
D macramphidisc umbel	25	.122	.099	.144	.009	25	.141	.106	.167	.015	3	.155	.152	.160	.004
L micramphidisc	25	.016	.014	.023	.002	25	.016	.013	.021	.002	15	.017	.014	.020	.002
L micramphidisc umbel	25	.005	.004	.007	.001	25	.005	.004	.006	.001	15	.005	.004	.005	.001
D micramphidisc umbel	25	.005	.004	.006	.001	25	.005	.004	.007	.001	15	.005	.004	.006	.000

	HCL 427					HCL 429				
	n	avg	min	max	std	n	avg	min	max	std
L dermal pentactin pinular ray	15	.117	.099	.129	.009	15	.137	.114	.160	.014
L dermal pentactin tangential ray	15	.044	.034	.053	.007	15	.050	.038	.084	.012
L atrial pentactin pinular ray										
L atrial pentactin tangential ray										
L microstauractin-pentactin ray	15	.100	.058	.140	.024	15	.094	.068	.129	.019
L macramphidisc	8	.337	.304	.380	.027	15	.401	.350	.471	.030
L macramphidisc umbel	8	.068	.053	.084	.011	15	.108	.091	.144	.017
D macramphidisc umbel	8	.096	.046	.137	.026	15	.144	.122	.160	.014
L micramphidisc	15	.017	.013	.029	.004	15	.016	.014	.018	.001
L micramphidisc umbel	15	.005	.004	.007	.001	15	.005	.004	.005	.000
D micramphidisc umbel	15	.005	.004	.006	.001	15	.006	.005	.007	.001

Source : MNHN, Paris

TABLE 5. — Some measurements of the spicules of *Hyalonema (Oonema?) microstauractina*.

	HCL 433					HCL 432					HCL 431				
	n	avg	min	max	std	n	avg	min	max	std	n	avg	min	max	std
L small dermal pentactin pinular ray	20	.103	.091	.137	.012	20	.102	.076	.137	.015	25	.152	.106	.258	.044
L small dermal pentactin tangential ray	20	.039	.030	.046	.005	20	.036	.023	.046	.007	25	.034	.023	.046	.006
L large dermal pentactin pinular ray	10	.296	.167	.494	.114	20	.350	.167	.517	.121					
L large dermal pentactin tangential ray	10	.044	.030	.061	.012	20	.050	.030	.076	.011					
L dermal diactin pinular ray	10	.337	.213	.486	.089	4	.447	.251	.608	.155					
L dermal diactin proximal ray	10	.407	.198	.608	.128	4	.456	.182	.608	.202					
L small atrial pentactin pinular ray	25	.169	.084	.228	.042	4	.122	.084	.152	.032	20	.131	.091	.182	.027
L small atrial pentactin tangential ray	25	.039	.030	.053	.006	4	.042	.027	.068	.019	20	.033	.023	.046	.007
L large atrial pentactin pinular ray	5	.404	.251	.532	.126	12	.262	.198	.357	.046					
L large atrial pentactin tangential ray	5	.046	.034	.061	.011	11	.053	.038	.068	.011					
L atrial diactin pinular ray	9	.421	.274	.547	.094	20	.528	.365	.722	.104	2	.638	.441	.836	.279
L atrial diactin proximal ray	9	.550	.274	.836	.161	9	.575	.137	.851	.266					
L microstauractine ray	20	.034	.011	.052	.012	20	.053	.032	.081	.012	20	.037	.016	.061	.012
L macramphidisc	24	.128	.038	.213	.056	20	.223	.106	.304	.044	20	.155	.084	.274	.049
L macramphidisc umbel	24	.037	.015	.061	.013	20	.067	.030	.091	.012	20	.056	.038	.091	.013
D macramphidisc umbel	24	.061	.021	.099	.024	20	.092	.053	.129	.016	20	.067	.046	.106	.016
L mesamphidisc	20	.074	.040	.152	.029	22	.084	.045	.153	.032	19	.081	.041	.131	.026
L mesamphidisc umbel	20	.029	.014	.072	.015	22	.031	.014	.068	.017	19	.037	.014	.065	.014
D mesamphidisc umbel	20	.021	.011	.046	.009	22	.025	.011	.054	.013	19	.026	.011	.040	.008
L micramphidisc	21	.023	.013	.050	.011	20	.020	.014	.040	.005	20	.015	.013	.018	.002
L micramphidisc umbel	21	.008	.004	.016	.004	20	.006	.004	.014	.002	20	.005	.004	.006	.001
D micramphidisc umbel	21	.008	.004	.020	.004	20	.007	.005	.012	.001	20	.006	.004	.007	.001
	HCL 430					HCL 434					HCL 435				
L small dermal pentactin pinular ray															
L small dermal pentactin tangential ray															
L large dermal pentactin pinular ray	16	.376	.312	.517	.055	15	.274	.213	.342	.037	8	.317	.167	.418	.084
L large dermal pentactin tangential ray	16	.57	.046	.076	.009	15	.038	.023	.053	.008	8	.057	.038	.122	.029
L dermal diactin pinular ray															
L dermal diactin proximal ray															
L small atrial pentactin pinular ray															
L small atrial pentactin tangential ray															
L large atrial pentactin pinular ray	20	.257	.160	.380	.067	15	.225	.137	.266	.034	5	.296	.228	.365	.050
L large atrial pentactin tangential ray	20	.059	.038	.175	.029	15	.042	.030	.053	.007	5	.046	.038	.053	.005
L atrial diactin pinular ray	15	.392	.205	.494	.072										
L atrial diactin proximal ray	15	.434	.114	.745	.165										
L microstauractin ray	15	.069	.045	.112	.016	15	.039	.029	.047	.006	2	.050	.050	.050	0
L macramphidisc	15	.318	.296	.350	.020	17	.238	.167	.334	.041	14	.270	.182	.327	.057
L macramphidisc umbel	15	.106	.099	.114	.006	17	.050	.038	.068	.009	14	.087	.061	.114	.014
D macramphidisc umbel	15	.139	.122	.152	.008	17	.076	.057	.114	.014	14	.112	.084	.129	.016
L mesamphidisc	15	.091	.050	.144	.029	15	.096	.054	.133	.023	5	.063	.050	.077	.010
L mesamphidisc umbel	15	.034	.013	.058	.013	15	.046	.027	.072	.013	5	.024	.018	.034	.007
D mesamphidisc umbel	15	.028	.014	.050	.012	15	.038	.020	.050	.009	5	.020	.014	.027	.006
L micramphidisc	15	.018	.014	.025	.003	15	.015	.011	.020	.002	5	.019	.014	.023	.005
L micramphidisc umbel	15	.006	.004	.009	.001	15	.005	.004	.008	.001	5	.006	.005	.007	.001
D micramphidisc umbel	15	.007	.006	.009	.001	15	.006	.005	.008	.001	5	.007	.006	.009	.001

Source : MNHN, Paris

TABLE 6. — Some measurements of the spicules of *Monorhaphis* which could be referred to *M. chuni* sensu stricto.

	5/2/1408					5/2/1351				
	n	avg	min	max	std	n	avg	min	max	std
L dermalia pinular	25	.149	.126	.184	.018	25	.161	.108	.202	.024
L dermalia tangential	25	.039	.025	.050	.006	25	.040	.032	.054	.005
L atrialia pinular	25	.146	.101	.209	.026	25	.143	.122	.173	.014
L atrialia tangential	25	.037	.018	.050	.008	25	.036	.029	.043	.005
L canalaria pinular	25	.073	.040	.104	.017	25	.072	.043	.097	.012
L canalaria tangential	25	.030	.022	.036	.004	25	.032	.025	.040	.004
L microhexactin ray	25	.141	.108	.176	.019	25	.147	.097	.180	.022
L macroamphidisc	5	.199	.122	.281	.076	6	.269	.229	.333	.040
L macramphidisc umbel	5	.111	.059	.178	.058	6	.165	.148	.185	.016
D macramphidisc umbel										
L mesamphidisc	1	.038	.038	.038						
L mesamphidisc umbel	1	.018	.018	.018						
D mesamphidisc umbel	1	.016	.016	.016						
L micramphidisc	25	.034	.028	.042	.004	25	.037	.028	.054	.006
L micramphidisc umbel	25	.009	.006	.012	.002	25	.008	.005	.012	.002
D micramphidisc umbel	25	.009	.006	.012	.001	25	.009	.006	.012	.001
	5/2/1422					5/2/1352				
L dermalia pinular	16	.171	.114	.236	.030	15	.165	.114	.213	.021
L dermalia tangential	16	.042	.030	.061	.008	15	.049	.030	.106	.017
L atrialia pinular	15	.161	.114	.198	.028	15	.148	.122	.175	.019
L atrialia tangential	15	.039	.030	.053	.005	15	.034	.023	.042	.006
L canalaria pinular	15	.082	.053	.122	.021	15	.080	.053	.099	.012
L canalaria tangential	15	.033	.023	.053	.009	15	.029	.023	.038	.005
L microhexactin ray	15	.147	.099	.205	.032	16	.152	.106	.213	.030
L macroamphidisc	2	.270	.236	.304	.048	3	.324	.312	.334	.012
L macramphidisc umbel						2	.038	.038	.038	0
D macramphidisc umbel	2	.190	.175	.205	.021	3	.101	.061	.152	.046
L mesamphidisc						8	.117	.065	.151	.026
L mesamphidisc umbel						8	.035	.014	.054	.014
D mesamphidisc umbel						8	.032	.014	.045	.011
L micramphidisc	16	.033	.023	.056	.008	15	.030	.025	.040	.004
L micramphidisc umbel	16	.008	.005	.013	.002	15	.007	.005	.011	.002
D micramphidisc umbel	16	.008	.006	.013	.002	15	.008	.006	.012	.002

TABLE 7. — Some measurements of the spicules of *Monorhaphis* which could be referred to previous *M. dives*.

	1908.09.24.064					1908.09.24.065					kt476				
	n	avg	min	max	std	n	avg	min	max	std	n	avg	min	max	std
L dermalia pinular	16	.162	.129	.236	.028	15	.217	.175	.266	.032	15	.210	.167	.251	.026
L dermalia tangential	16	.034	.015	.046	.008	15	.049	.038	.068	.008	15	.046	.034	.061	.008
L atrialia pinular	15	.241	.167	.281	.034										
L atrialia tangential	15	.040	.030	.053	.006										
L canalaria pinular	15	.080	.061	.099	.014						4	.082	.068	.114	.022
L canalaria tangential	15	.031	.023	.038	.005						4	.033	.023	.046	.011
L microhexactin ray	16	.139	.091	.167	.021	15	.099	.076	.118	.014	6	.106	.065	.137	.023
L macramphidisc	1	.334	.334	.334											
L macramphidisc umbel															
D macramphidisc umbel	1	.175	.175	.175											
L mesamphidisc	16	.104	.086	.146	.015	16	.101	.085	.131	.015	15	.084	.041	.104	.016
L mesamphidisc umbel	14	.030	.022	.043	.006	11	.035	.020	.058	.012	13	.028	.016	.045	.009
D mesamphidisc umbel	16	.032	.022	.065	.011	16	.039	.020	.061	.013	15	.030	.020	.052	.011
L micramphidisc	16	.029	.020	.038	.005	15	.030	.023	.047	.006	15	.025	.018	.032	.004
L micramphidisc umbel	16	.008	.006	.013	.001	15	.009	.006	.016	.003	15	.008	.007	.011	.001
D micramphidisc umbel	16	.009	.007	.013	.002	15	.010	.008	.016	.002	15	.008	.006	.011	.001

Source : MNHN, Paris

TABLE 8. — Some measurements of the spicules of *Monorhaphis* which could be referred to previous *M. intermedia*.

	HCL 410					fr767					HCL 411				
	n	avg	min	max	std	n	avg	min	max	std	n	avg	min	max	std
L dermalia pinular	15	.233	.175	.266	.029	15	.231	.182	.304	.047	15	.157	.091	.243	.050
L dermalia tangential	15	.052	.038	.068	.008	15	.050	.038	.068	.008	15	.035	.027	.046	.006
L atrialia pinular											15	.176	.137	.198	.019
L atrialia tangential											15	.035	.030	.042	.003
L canalaria pinular															
L canalaria tangential															
L microhexactin ray	15	.083	.045	.140	.026	15	.069	.036	.110	.019	15	.034	.022	.041	.006
L macramphidisc						4	.183	.171	.194	.013					
L macramphidisc umbel															
D macramphidisc umbel						4	.100	.085	.126	.018					
L mesamphidisc	17	.078	.061	.097	.011	10	.077	.050	.117	.022	1	.063	.063	.063	
L mesamphidisc umbel	17	.024	.018	.032	.005	10	.026	.020	.036	.005	1	.031	.031	.031	
D mesamphidisc umbel	17	.019	.016	.023	.002	10	.026	.018	.031	.005	1	.023	.023	.023	
L micramphidisc	15	.031	.025	.036	.003	15	.037	.031	.047	.005	15	.028	.020	.050	.007
L micramphidisc umbel	15	.008	.005	.011	.002	15	.009	.007	.013	.001	15	.008	.006	.013	.001
D micramphidisc umbel	15	.009	.008	.010	.001	15	.011	.009	.013	.001	15	.008	.007	.014	.002
	HCL 412					fr867.1					HCL 408				
L dermalia pinular	15	.153	.114	.198	.027	15	.292	.251	.380	.030	15	.251	.220	.289	.019
L dermalia tangential	15	.035	.023	.038	.005	15	.055	.046	.091	.011	15	.052	.030	.061	.010
L atrialia pinular	15	.158	.076	.205	.034										
L atrialia tangential	15	.035	.023	.046	.006										
L canalaria pinular															
L canalaria tangential															
L microhexactin ray	15	.030	.020	.041	.006	15	.066	.045	.117	.022	15	.076	.050	.135	.020
L macroamphidisc						8	.194	.151	.241	.033	16	.075	.061	.088	.006
L macramphidisc umbel											16	.023	.018	.036	.004
D macramphidisc umbel						8	.123	.068	.149	.028	16	.018	.016	.025	.002
L mesamphidisc						15	.081	.063	.108	.013	1	.176	.176	.176	
L mesamphidisc umbel						15	.030	.020	.049	.007					
D mesamphidisc umbel						15	.026	.021	.038	.005	1	.068	.068	.068	
L micramphidisc	16	.024	.012	.032	.004	15	.033	.029	.040	.004	16	.035	.031	.040	.003
L micramphidisc umbel	16	.006	.004	.009	.001	15	.009	.007	.011	.001	16	.008	.005	.011	.001
D micramphidisc umbel	16	.007	.004	.008	.001	15	.010	.008	.011	.001	16	.009	.006	.011	.001
	p540					HCL 406					HCL 407				
L dermalia pinular	15	.234	.182	.281	.028	16	.216	.144	.312	.053	15	.244	.114	.327	.067
L dermalia tangential	15	.049	.038	.076	.010	16	.039	.030	.053	.007	15	.040	.030	.053	.005
L atrialia pinular						15	.201	.160	.251	.028	15	.195	.160	.220	.017
L atrialia tangential						15	.038	.030	.053	.006	15	.032	.023	.042	.006
L canalaria pinular															
L canalaria tangential															
L microhexactin ray	15	.057	.040	.079	.013	15	.035	.029	.045	.005	15	.033	.025	.043	.007
L macroamphidisc						3	.182	.158	.230	.042	4	.189	.126	.265	.065
L macramphidisc umbel															
D macramphidisc umbel						3	.098	.090	.113	.014	4	.123	.076	.176	.050
L mesamphidisc	15	.085	.068	.115	.013	18	.106	.085	.130	.014	17	.084	.052	.119	.020
L mesamphidisc umbel	13	.023	.018	.032	.004	13	.040	.018	.059	.016	9	.026	.014	.052	.013
D mesamphidisc umbel	15	.029	.023	.047	.007	18	.033	.018	.050	.010	17	.029	.016	.049	.010
L micramphidisc	15	.037	.022	.041	.005	15	.030	.023	.040	.005	15	.030	.025	.032	.002
L micramphidisc umbel	15	.009	.007	.013	.002	15	.008	.005	.012	.002	15	.009	.005	.011	.001
D micramphidisc umbel	15	.012	.009	.018	.003	15	.008	.007	.012	.002	15	.009	.007	.011	.001

Source : MNHN, Paris

TABLE 8. — Some measurements of the spicules of *Monorhaphis* which could be referred to previous *M. intermedia* (suite).

	HCL 445					HCL 409					HCL 405				
	n	avg	min	max	std	n	avg	min	max	std	n	avg	min	max	std
L dermalia pinular	15	.159	.106	.251	.033	16	.213	.114	.441	.080	15	.156	.091	.190	.027
L dermalia tangential	15	.042	.038	.053	.005	15	.052	.038	.061	.007	15	.037	.015	.046	.008
L atrialia pinular	15	.195	.160	.228	.017						15	.172	.144	.198	.018
L atrialia tangential	15	.041	.030	.053	.006						15	.035	.030	.038	.003
L canalaria pinular															
L canalaria tangential															
L microhexactin ray	17	.050	.032	.070	.009	16	.049	.025	.063	.011	15	.034	.023	.043	.006
L macramphidisc	1	.155	.155	.155		6	.197	.151	.252	.041					
L macramphidisc umbel															
D macramphidisc umbel	1	.090	.090	.090		6	.103	.072	.140	.028					
L mesamphidisc	1	.077	.077	.077		15	.130	.072	.173	.026	5	.098	.088	.108	.009
L mesamphidisc umbel	1	.027	.027	.027		4	.040	.029	.058	.013	1	.047	.047	.047	
D mesamphidisc umbel	1	.023	.023	.023		15	.048	.027	.077	.014	5	.031	.029	.032	.002
L micramphidisc	15	.027	.022	.034	.004	15	.029	.025	.036	.003	15	.025	.021	.032	.003
L micramphidisc umbel	15	.008	.005	.011	.001	15	.008	.006	.009	.001	15	.008	.005	.009	.001
D micramphidisc umbel	15	.009	.007	.010	.001	15	.009	.007	.011	.001	15	.008	.007	.011	.001

TABLE 9. — Comparative measurements of various spicule parameters of *Monorhaphis* collected from different locations and of previously different species.

	I	II		III		IV		V		VI	
	avg	min	max	min	max	min	max	min	max	min	max
L dermalia pinular	.200	.170	.190	.108	.236	.129	.266	.265	.320	.091	.441
L dermalia tangential	.050	.045	.053	.025	.106	.015	.068	.051	.067	.015	.091
L atrialia pinular				.101	.209	.167	.281			.076	.228
L atrialia tangential				.018	.050	.030	.053			.023	.053
L canalaria pinular	.120	.075	.100	.040	.122	.061	.114				
L canalaria tangential	.050	.038	.050	.022	.053	.023	.046				
L microhexactin ray	.160	.055	.150	.097	.213	.065	.167	.070	.092	.020	.110
L macramphidisc	.320	.310	.330	.122	.334	.334	?	.160	.335	.061	.265
L macramphidisc umbel				.038	.185						
D macramphidisc umbel	.200	.200	.242	.061	.205	.175	?	.064	.214	.016	.176
L mesamphidisc				.038	.151	.084	.131	.090	.151	.050	.130
L mesamphidisc umbel				.014	.054	.016	.058	.025	.044	.014	.059
D mesamphidisc umbel				.014	.045	.020	.065			.016	.077
L micramphidisc	.040	.023	.038	.023	.056	.018	.047	.035	.048	.020	.050
L micramphidisc umbel	.012	.006	.009	.005	.013	.006	.016	.009	.012	.005	.013
D micramphidisc umbel		.010	.010	.006	.013	.006	.016	.012	.016	.006	.018

I - " *M. chuni* " according to SCHULZE (1904)
II - " *M. chuni* " according to IJIMA (1927)
III - specimens similar to " *M. chuni* ": 5/2/1422; 5/2/1352; 5/2/1408; 5/2/1351
IV - " *M. dives* ": 1908.09.24.065; 1908.09.24.064; kt476
V - " *M. intermedia* " according to LI JINHE (1987)
VI - specimens off New Caledonia and Australia similar to " *M. intermedia* "

TABLE 10. — Some measurements of the spicules of *Sericolophus calsubus*.

	HCL 155					HCL 446				
	n	avg	min	max	std	n	avg	min	max	std
dermal pinular ray	25	.214	.133	.361	.052	15	.222	.099	.281	.048
dermal tangential ray	25	.086	.053	.114	.015	15	.058	.034	.106	.024
atriual pinular ray	25	.273	.144	.429	.077	15	.313	.213	.608	.096
atriual tangential ray	25	.066	.046	.087	.012	15	.056	.046	.068	.007
microhexactin ray	25	.115	.091	.137	.014	19	.100	.068	.175	.027
L micramphidisc	25	.023	.018	.031	.004	15	.040	.027	.056	.008
L micramphidisc umbel	25	.009	.007	.012	.001	15	.012	.007	.018	.003
D micramphidisc umbel	25	.008	.006	.012	.001	15	.011	.007	.014	.002
L micruncinate	16	.051	.034	.076	.013	16	.062	.032	.108	.021

Source : MNHN, Paris

TABLE 11. — Some measurements of the spicules of *Sericolophus neocaledonicus*.

	HCL 156					HCL 159					HCL 163				
	n	avg	min	max	std	n	avg	min	max	std	n	avg	min	max	std
L dermal pinular ray	25	.163	.118	.190	.021						15	.208	.084	.289	.053
L dermal tangential ray	25	.075	.046	.129	.017						15	.073	.046	.106	.021
L atrial pinular ray	25	.219	.144	.289	.048						15	.387	.213	.532	.094
L atrial tangential ray	25	.076	.046	.114	.015						15	.102	.068	.144	.022
L thick microhexactin ray	25	.090	.067	.131	.017	2	.080	.068	.091	.016	15	.084	.046	.114	.018
L thin microhexactin ray	25	.120	.059	.204	.038	4	.082	.061	.091	.014	11	.082	.053	.122	.019
L mesamphidisc	25	.074	.057	.092	.008	14	.048	.032	.076	.011	15	.085	.063	.103	.010
L mesamphidisc umbel	25	.030	.024	.034	.002	14	.016	.011	.022	.003	15	.033	.022	.040	.005
D mesamphidisc umbel	25	.025	.020	.031	.002	14	.015	.010	.022	.003	15	.026	.023	.029	.001
L micramphidisc	25	.033	.019	.048	.007	14	.027	.020	.036	.005	15	.033	.025	.047	.007
L micramphidisc umbel	25	.010	.007	.015	.002	14	.010	.007	.013	.002	15	.010	.008	.016	.002
D micramphidisc umbel	25	.009	.005	.013	.002	14	.009	.007	.013	.002	15	.009	.007	.014	.002
L micruncinate	4	.074	.044	.115	.031	13	.067	.045	.086	.015	8	.090	.056	.115	.023
	HCL 161					HCL 170					HCL 165				
L dermal pinular ray						25	.219	.114	.285	.039	25	.165	.095	.262	.041
L dermal tangential ray						25	.090	.053	.137	.024	25	.084	.057	.118	.016
L atrial pinular ray						25	.310	.182	.456	.069	25	.226	.114	.327	.051
L atrial tangential ray						5	.074	.042	.118	.020	25	.099	.053	.141	.023
L thick microhexactin ray	4	.072	.053	.084	.013	25	.068	.056	.087	.008	25	.107	.068	.148	.021
L thin microhexactin ray	9	.069	.046	.084	.013	10	.076	.061	.085	.007					
L mesamphidisc	2	.041	.038	.043	.004	25	.074	.056	.085	.008	25	.077	.058	.090	.008
L mesamphidisc umbel	2	.016	.014	.018	.003	25	.029	.022	.033	.003	25	.031	.020	.036	.004
D mesamphidisc umbel	2	.014	.013	.014	.001	25	.024	.019	.028	.002	25	.026	.018	.029	.003
L micramphidisc	4	.023	.020	.025	.003	25	.040	.027	.047	.005	25	.032	.015	.040	.006
L micramphidisc umbel	4	.009	.009	.011	.001	25	.015	.011	.019	.002	25	.012	.006	.017	.002
D micramphidisc umbel	4	.008	.007	.009	.001	25	.011	.009	.014	.001	25	.010	.007	.014	.002
L micruncinate	15	.063	.031	.097	.019	16	.073	.041	.100	.015	16	.067	.043	.099	.016

TABLE 12. — Some measurements of the spicules of *Sericolophus hawaiicus*.

	co475					co471				
	n	avg	min	max	std	n	avg	min	max	std
L pinular ray one side	50	.118	.068	.175	.022					
L tangential ray one side	50	.053	.038	.072	.009					
L pinular ray another side	50	.135	.068	.182	.024					
L tangential ray another side	50	.055	.038	.072	.008					
L microhexactin ray	25	.082	.065	.098	.009	25	.086	.063	.117	.013
L microamphidisc	50	.030	.020	.045	.005	29	.034	.021	.065	.009
L microamphidisc umbel	50	.009	.005	.018	.002	29	.010	.007	.021	.003
D microamphidisc umbel	50	.008	.005	.014	.002	29	.011	.008	.019	.003

TABLE 13. — Some measurements of the spicules of *Sericolophus cidaricus*.

	HCL 180				
	n	avg	min	max	std
dermal pinular ray	25	.437	.217	.813	.135
dermal tangential ray	25	.079	.038	.129	.026
atrial pinular ray	25	.569	.186	.904	.213
atrial tangential ray	25	.089	.057	.148	.022
microhexactin ray	25	.091	.076	.107	.010
L mesamphidisc	25	.080	.058	.104	.011
L mesamphidisc umbel	25	.027	.013	.032	.005
D mesamphidisc umbel	25	.026	.018	.030	.003
L micramphidisc	9	.034	.016	.040	.007
L micramphidisc umbel	9	.009	.005	.013	.002
D micramphidisc umbel	9	.010	.005	.014	.003
L micruncinate	25	.086	.061	.120	.016

Source : MNHN, Paris

TABLE 14. — Ranges of spicule measurements of *Sericolophus* species.

	S. reflexus (after IJIMA & OKADA, 1932, REISWIG, 1991)		*S. calsubus*		*S. neocaledonicus*	
	L min-max	D min-max	L min-max	D min-max	L min-max	D min-max
dermal pentactin pinular ray	0.07-0.30	0.034	0.10-0.36	0.007-0.019	0.07-0.34	0.007-0.015
dermal pentactin tangential ray	0.09-0.11	0.006-0.007	0.03-0.11	0.004-0.006	0.03-0.14	0.006
atrial pentactin pinular ray	0.07-0.30	0.034	0.14-0.61	0.007-0.022	0.08-1.08	0.015-0.019
atrial pentactin tangential ray	0.09-0.11	0.006-0.007	0.05-0.09	0.004-0.011	0.01-0.18	0.007
microhexactin ray (thin-rayed)	0.08-0.17	0.004-0.010	0.07-0.18	0.007-0.011	0.05-0.21	0.004-0.007
microhexactin ray (thick-rayed)					0.05-0.21	0.015-0.030
micruncinate	0.04-0.19		0.03-0.11	0.004	0.04-0.14	0.004
macramphidisc	0.16-0.17					
mesoamphidisc	0.04-0.12				0.03-0.12	
microamphidisc	0.016-0.050		0.018-0.056		0.015-0.050	

	S. cidaricus		*S. hawaiicus*	
dermal pentactin pinular ray	0.22-0.81	0.004-0.022	0.07-0.18	0.004-0.011
dermal pentactin tangential ray	0.04-0.13	0.004-0.013	0.04-0.07	0.004
atrial pentactin pinular ray	0.19-1.90	0.015-0.019	0.07-0.18	0.004-0.011
atrial pentactin tangential ray	0.06-0.15	0.013	0.04-0.07	0.004
microhexactin ray (thin-rayed)	0.08-0.11	0.007-0.009	0.06-0.12	0.007
microhexactin ray (thick-rayed)				
micruncinate	0.06-0.12	0.011-0.015	0.10-0.50	0.004
macramphidisc				
mesoamphidisc	0.06-0.10			
microamphidisc	0.016-0.040		0.020-0.065	

TABLE 15. — Some measurements of the spicules of *Semperella varioactina*.

	HCL 202				
	n	avg	min	max	std
L pinular pentactin, pinular ray	25	.149	.099	.198	.027
L pinular pentactin, tangential ray	25	.092	.061	.137	.018
L micropentactin ray	26	.122	.053	.220	.050
L micromonactin	26	.212	.099	.327	.067
L amphidisc	28	.066	.032	.108	.021
L amphidisc umbel	28	.023	.009	.038	.008
D amphidisc umbel	28	.020	.007	.032	.008

TABLE 16. — Some measurements of the spicules of *Semperella abyssalis*.

	HCL 203					HCL 204					HCL 205				
	n	avg	min	max	std	n	avg	min	max	std	n	avg	min	max	std
L pinular pentactin pinular ray	44	.180	.122	.303	.042	15	.135	.106	.160	.015	15	.148	.114	.198	.024
L pinular pentactin, tangential ray	44	.098	.053	.211	.031	15	.100	.068	.122	.014	15	.090	.053	.106	.015
L micropentactin ray	15	.082	.046	.129	.028	15	.093	.068	.114	.014	15	.087	.061	.114	.016
L amphidisc	27	.055	.020	.115	.027	25	.047	.022	.095	.018	25	.047	.020	.092	.022
L amphidisc umbel	27	.013	.004	.027	.007	25	.013	.007	.027	.005	25	.015	.005	.031	.008
D amphidisc umbel	27	.012	.005	.023	.006	25	.011	.006	.023	.004	25	.012	.006	.022	.005

	HCL 206					HCL 207					HCL 208				
L pinular pentactin pinular ray	15	.143	.122	.175	.017	15	.148	.122	.175	.015	15	.139	.099	.167	.021
L pinular pentactin, tangential ray	15	.086	.068	.114	.015	15	.085	.061	.114	.016	15	.084	.053	.106	.013
L micropentactin ray	15	.082	.049	.114	.018	15	.104	.061	.167	.033	15	.077	.046	.114	.018
L amphidisc	25	.061	.027	.119	.024	16	.038	.016	.072	.017	15	.039	.020	.085	.019
L amphidisc umbel	25	.019	.007	.036	.008	16	.012	.006	.025	.006	15	.012	.006	.022	.005
D amphidisc umbel	25	.015	.005	.025	.006	16	.010	.005	.020	.004	15	.009	.005	.018	.004

Source : MNHN, Paris

TABLE 17. — Some measurements of the pinular pentactins of *Semperella crosnieri* (HCL 209) collected from different places of the surface.

	HCL 209				
	n	avg	min	max	std
L # pinular pentactin from one side, pinular ray	15	.132	.084	.190	.031
L # pinular pentactin from one side, tangential ray	15	.062	.046	.084	.013
L * pinular pentactin from one side, pinular ray	15	.152	.129	.182	.020
L * pinular pentactin from one side, tangential ray	15	.066	.046	.084	.009
L # pinular pentactin from another side, pinular ray	15	.135	.091	.167	.019
L # pinular pentactin from another side, tangential ray	15	.062	.038	.084	.013
L * pinular pentactin from lateral side, pinular ray	15	.168	.137	.205	.022
L * pinular pentactin from lateral side, tangential ray	15	.071	.053	.091	.010

- areas of the surface covered with small-meshed laticework - probably dermalia
* - areas of the surface covered with big-meshed laticework - probably atrialia

TABLE 18. — Some measurements of the spicules of *Semperella crosnieri*.

	HCL 209					HCL 210				
	n	avg	min	max	std	n	avg	min	max	std
L dermal pentactin, pinular ray	30	.134	.084	.190	.025	25	.127	.076	.163	.024
L dermal pentactin, tangential ray	30	.062	.038	.084	.013	25	.064	.038	.084	.012
L atrial pentactin, pinular ray	30	.160	.129	.205	.022	25	.161	.076	.236	.038
L atrial pentactin, tangential ray	30	.068	.046	.091	.010	25	.073	.046	.106	.014
L micropentactin ray	25	.094	.053	.137	.020	25	.113	.057	.171	.032
L amphidisc	25	.020	.014	.029	.003	25	.020	.016	.025	.002
L amphidisc umbel	25	.006	.005	.009	.001	25	.006	.005	.008	.001
D amphidisc umbel	25	.007	.005	.011	.001	25	.007	.006	.008	.001
	HCL 212					HCL 211				
L dermal pentactin, pinular ray	25	.133	.072	.179	.028	25	.200	.133	.300	.038
L dermal pentactin, tangential ray	25	.063	.042	.103	.013	25	.068	.046	.087	.012
L atrial pentactin, pinular ray	25	.146	.084	.205	.032	25	.206	.114	.342	.058
L atrial pentactin, tangential ray	25	.069	.038	.133	.020	25	.069	.049	.087	.009
L micropentactin ray	35	.063	.031	.080	.011	25	.078	.052	.093	.013
L amphidisc	25	.019	.016	.023	.002	25	.020	.016	.023	.002
L amphidisc umbel	25	.006	.005	.007	.001	25	.006	.005	.009	.001
D amphidisc umbel	25	.008	.006	.010	.001	25	.007	.006	.008	.001

TABLE 19. — Some measurements of the pinular pentactins of *Poliopogon micropentactinus* collected from different places of the surface.

	HCL 215				
	n	avg	min	max	std
L pentactin of the convex surface, pinular ray	15	.176	.129	.213	.023
L pentactin of the convex surface, tangential ray	15	.094	.076	.122	.014
L pentactin of one concave surface, pinular ray	15	.176	.137	.213	.020
L pentactin of one concave surface, tangential ray	15	.090	.076	.106	.012
L pentactin of the other concave surface, pinular ray	15	.174	.144	.220	.021
L pentactin of the other concave surface, tangential ray	15	.090	.076	.114	.012
L pentactin of the rib, pinular ray	15	.216	.175	.258	.024
L pentactin of the rib, tangential ray	15	.089	.030	.137	.028

Source : MNHN, Paris

TABLE 20. — Some measurements of spicules of *Poliopogon micropentactinus*.

	HCL 213					HCL 215					HCL 214				
	n	avg	min	max	std	n	avg	min	max	std	n	avg	min	max	std
L pinular pentactin of one side pinular ray	25	.194	.122	.300	.041	15	.176	.137	.213	.020	25	.263	.190	.334	.033
L pinular pentactin of one side tangential ray	25	.070	.034	.122	.026	15	.090	.076	.106	.012	25	.114	.084	.148	.017
L pinular pentactin of another side pinular ray	25	.172	.114	.262	.036	15	.174	.144	.220	.021	25	.158	.129	.186	.016
L pinular pentactin of another side tangential ray	25	.080	.034	.122	.017	15	.090	.076	.114	.012	25	.081	.053	.106	.013
L micropentactin ray	25	.095	.057	.137	.021	20	.124	.076	.198	.034	25	.092	.052	.126	.022
L amphidisc	25	.048	.027	.095	.022	24	.048	.029	.085	.013	50	.063	.015	.115	.028
L amphidisc umbel	25	.016	.009	.031	.007	24	.016	.009	.027	.004	50	.022	.005	.041	.010
D amphidisc umbel	25	.013	.008	.024	.004	24	.010	.007	.016	.002	50	.016	.005	.026	.006

TABLE 21. — Some measurements of spicules of *Poliopogon claviculus*.

	HCL 458				
	n	avg	min	max	std
L dermal pentactin pinular ray	25	.243	.078	.392	.092
L dermal pentactin tangential ray	25	.064	.044	.096	.015
L atrial pentactin pinular ray	25	.133	.078	.174	.019
L atrial pentactin tangential ray	25	.055	.030	.078	.010
L microhexactin ray	25	.092	.061	.122	.016
L macramphidisc	25	.222	.131	.287	.040
D macramphidisc umbel	25	.143	.070	.183	.032
L mesamphidisc	25	.121	.061	.200	.035
L mesamphidisc umbel	25	.043	.017	.078	.015
D mesamphidisc umbel	25	.031	.010	.052	.010
L micramphidisc	25	.043	.032	.058	.006
L micramphidisc umbel	25	.015	.012	.018	.002
D micramphidisc umbel	25	.012	.008	.016	.002

TABLE 22. — Some measurements of spicules of *Poliopogon zonecus* (HCL 459).

	HCL 459				
	n	avg	min	max	std
L dermal pentactin pinular ray	25	.148	.113	.200	.023
L dermal pentactin tangential ray	25	.085	.070	.131	.017
L atrial pentactin pinular ray	25	.147	.104	.191	.021
L atrial pentactin tangential ray	25	.080	.061	.122	.015
L microhexactin ray	25	.121	.078	.191	.027
L micramphidisc	25	.034	.025	.047	.005
L micramphidisc umbel	25	.008	.006	.010	.001
D micramphidisc umbel	25	.009	.007	.012	.001

Source : MNHN, Paris

TABLE 23. — Some measurements of the spicules of *Pheronema pilosum*.

	holotype					PQR 9402					fr 870				
	n	avg	min	max	std	n	avg	min	max	std	n	avg	min	max	std
Length of the body												50			
Diameter of the body															
L dermalia pinular			.080	.096		25	.089	.061	.129	.016	25	.126	.068	.171	.024
L dermalia tangential			.100	.120		25	.084	.065	.118	.013	25	.117	.053	.148	.020
L atrialia pinular			.125	.160		25	.134	.080	.190	.033	25	.128	.095	.213	.027
L atrialia tangential			.140	.160		25	.121	.076	.163	.025	25	.104	.076	.133	.014
L micropentactin ray	6	.076	.056	.098	.014	25	.092	.054	.131	.019	25	.068	.044	.115	.020
L amphidisc			.050	.065		25	.056	.043	.071	.007	25	.049	.041	.063	.006
L amphidisc umbel			.023	.025		25	.020	.014	.032	.004	25	.014	.011	.016	.001
D amphidisc umbel			.015	.025		25	.016	.011	.023	.003	25	.013	.011	.016	.001
L micruncinate						3	.200	.114	.296	.092	21	.377	.243	.486	.057
	HCL 253					HCL 461					HCL 235				
Length of the body		40					40					55			
Diameter of the body			25	40			35						32	55	
L dermalia pinular	25	.198	.099	.274	.047	15	.094	.068	.122	.016	25	.133	.084	.243	.041
L dermalia tangential	25	.164	.068	.236	.038	15	.099	.076	.129	.016	25	.107	.061	.137	.021
L atrialia pinular	25	.098	.053	.144	.025	15	.105	.061	.129	.018	25	.118	.084	.175	.023
L atrialia tangential	25	.086	.038	.129	.026	15	.103	.068	.144	.022	25	.103	.068	.137	.019
L micropentactin ray						25	.090	.068	.122	.017	15	.090	.053	.122	.018
L amphidisc	25	.058	.045	.072	.006	11	.054	.022	.110	.023	25	.066	.033	.081	.010
L amphidisc umbel	25	.017	.014	.022	.002	11	.017	.013	.027	.005	25	.025	.009	.033	.004
D amphidisc umbel	25	.015	.012	.019	.002	11	.015	.011	.020	.003	25	.021	.009	.026	.003
L micruncinate						15	.484	.281	.692	.140	25	.371	.129	.798	.235
	1936.03.04.080.					HCL 242					5/2/390.9				
Length of the body		70					75					80			
Diameter of the body		70						45	55				35	40	
L dermalia pinular	15	.097	.068	.129	.018	25	.105	.068	.137	.018	25	.088	.046	.144	.023
L dermalia tangential	15	.101	.068	.129	.019	25	.099	.053	.137	.021	25	.090	.065	.107	.011
L atrialia pinular	15	.133	.084	.198	.033	25	.126	.068	.175	.021	25	.092	.068	.118	.013
L atrialia tangential	15	.127	.099	.167	.021	25	.131	.057	.175	.026	25	.096	.072	.118	.011
L micropentactin ray	25	.067	.026	.129	.032						25	.079	.048	.113	.015
L amphidisc	15	.056	.045	.065	.006	25	.067	.029	.079	.010	25	.063	.029	.092	.014
L amphidisc umbel	15	.015	.011	.020	.002	25	.026	.010	.034	.005	25	.020	.007	.030	.006
D amphidisc umbel	15	.014	.012	.018	.002	25	.021	.011	.027	.003	25	.018	.008	.023	.004
L micruncinate	15	.259	.220	.304	.024	25	.407	.198	.593	.138	25	.128	.091	.236	.028
	HCL 218					HCL 220					HCL 252				
Length of the body		80					100					120			
Diameter of the body		50					70						10	65	
L dermalia pinular	15	.091	.076	.122	.017	15	.134	.061	.304	.069	15	.205	.152	.266	.033
L dermalia tangential	15	.084	.053	.129	.017	15	.112	.068	.190	.038	15	.131	.091	.160	.022
L atrialia pinular	15	.090	.068	.106	.012	15	.168	.091	.357	.077	15	.124	.084	.266	.047
L atrialia tangential	15	.088	.068	.122	.016	15	.133	.099	.205	.037	15	.097	.068	.167	.026
L micropentactin ray															
L amphidisc	3	.059	.034	.072	.021	25	.096	.058	.151	.031	15	.050	.041	.061	.005
L amphidisc umbel	3	.021	.009	.027	.010	25	.034	.020	.052	.010	15	.013	.009	.016	.002
D amphidisc umbel	3	.015	.010	.020	.005	25	.026	.016	.045	.008	15	.013	.010	.016	.002
L micruncinate	15	.464	.304	.912	.145	8	.485	.296	.631	.110	15	.420	.228	.540	.084

Source : MNHN, Paris

TABLE 24. — Some measurements of the spicules of *Pheronema semiglobosum*.

	HCL 48					HCL 220					HCL 49 (p4324)				
	n	avg	min	max	std	n	avg	min	max	std	n	avg	min	max	std
Length of the body		60					7					12			
Diameter of the body			90	95				10	12				15	20	
L dermalia pinular	25	.128	.076	.213	.040	15	.100	.068	.129	.017	15	.100	.076	.122	.014
L dermalia tangential	25	.054	.034	.091	.012	15	.062	.053	.076	.008	15	.063	.046	.076	.008
L atrialia pinular	25	.254	.144	.372	.062	15	.109	.076	.152	.021	15	.131	.099	.175	.025
L atrialia tangential	25	.060	.027	.103	.021	15	.059	.038	.076	.010	15	.063	.046	.099	.014
L macramphidisc	25	.117	.068	.167	.027	7	.168	.099	.236	.060	16	.178	.137	.228	.026
L umbel macramphidisc	25	.042	.027	.053	.007	7	.047	.030	.061	.013	16	.054	.038	.068	.008
D umbel macramphidisc	25	.042	.027	.057	.008	7	.055	.030	.076	.019	16	.064	.049	.076	.007
L micramphidisc	25	.021	.017	.032	.003	15	.036	.027	.045	.005	8	.030	.018	.036	.005
L umbel micramphidisc	25	.007	.005	.013	.002	15	.011	.009	.013	.001	8	.010	.005	.013	.003
D umbel micramphidisc	25	.006	.005	.010	.001	15	.009	.007	.013	.001	8	.008	.005	.011	.002
L micruncinate	25	.190	.099	.327	.071	2	.635	.623	.646	.016	6	.224	.137	.289	.053

	HCL 49 (p3875)					HCL 49 (p4648)					HCL 282				
	n	avg	min	max	std	n	avg	min	max	std	n	avg	min	max	std
Length of the body		15					35					55			
Diameter of the body		15					50						30	50	
L dermalia pinular	15	.140	.053	.236	.045	25	.163	.106	.220	.025	25	.093	.068	.129	.018
L dermalia tangential	15	.063	.038	.076	.011	25	.073	.053	.099	.014	25	.056	.046	.068	.008
L atrialia pinular	15	.212	.122	.312	.064	25	.170	.091	.289	.055	25	.103	.084	.129	.011
L atrialia tangential	15	.075	.042	.091	.017	25	.069	.038	.099	.017	25	.058	.046	.091	.010
L macramphidisc	6	.139	.068	.182	.043	25	.154	.114	.190	.024	5	.221	.205	.239	.013
L umbel macramphidisc	6	.051	.030	.061	.011	25	.055	.030	.068	.010	5	.065	.061	.068	.004
D umbel macramphidisc	6	.044	.030	.057	.009	25	.054	.042	.068	.006	5	.067	.053	.076	.009
L micramphidisc	15	.026	.022	.032	.003	25	.025	.020	.031	.003	25	.029	.020	.034	.004
L umbel micramphidisc	15	.009	.007	.011	.001	25	.008	.005	.010	.001	25	.009	.007	.011	.001
D umbel micramphidisc	15	.007	.005	.008	.001	25	.007	.005	.008	.001	25	.008	.007	.009	.001
L micruncinate	15	.215	.084	.540	.122	25	.162	.114	.304	.037	25	.138	.099	.160	.015

	HCL 287					HCL 278				
	n	avg	min	max	std	n	avg	min	max	std
Length of the body		100					120			
Diameter of the body		110						130	155	
L dermalia pinular	15	.103	.061	.152	.033	25	.122	.091	.190	.024
L dermalia tangential	15	.055	.023	.084	.015	25	.066	.046	.091	.011
L atrialia pinular	15	.134	.084	.258	.049	25	.155	.076	.281	.041
L atrialia tangential	15	.067	.046	.099	.014	25	.074	.038	.133	.020
L macramphidisc	7	.212	.182	.243	.020					
L umbel macramphidisc	7	.045	.015	.068	.020					
D umbel macramphidisc	7	.060	.038	.076	.016					
L micramphidisc	15	.031	.023	.040	.005	25	.029	.018	.065	.009
L umbel micramphidisc	15	.009	.007	.011	.001	25	.009	.006	.013	.001
D umbel micramphidisc	15	.007	.005	.009	.001	25	.007	.005	.009	.001
L micruncinate	15	.164	.129	.205	.024	25	.142	.091	.182	.019

Source : MNHN, Paris

TABLE 25. — Some measurements of the spicules of *Pheronema conicum*.

	HCL 46					HCL 318					HCL 314				
	n	avg	min	max	std	n	avg	min	max	std	n	avg	min	max	std
Length of the body		45					15					19			
Diameter of the body		60					19					15			
L dermalia pinular	25	.162	.106	.251	.036	15	.062	.049	.068	.005	25	.105	.053	.198	.047
L dermalia tangential	25	.142	.106	.190	.022	15	.052	.038	.061	.007	25	.090	.046	.152	.036
L atrialia pinular	25	.143	.076	.319	.056	15	.155	.068	.274	.064	25	.068	.053	.084	.009
L atrialia tangential	25	.089	.053	.114	.016	15	.093	.061	.129	.018	25	.068	.038	.099	.013
L dermal macramphidisc	4	.082	.076	.091	.007	15	.194	.046	.251	.050	15	.207	.152	.243	.024
L umbel dermal macramphidisc	4	.032	.027	.038	.005	15	.064	.019	.076	.015	15	.067	.057	.076	.006
D umbel dermal macramphidisc	4	.032	.027	.038	.007	15	.069	.023	.091	.015	15	.062	.053	.076	.006
L atrial macramphidisc						20	.105	.038	.182	.054	15	.121	.049	.220	.056
L umbel atrial macramphidisc						20	.039	.018	.061	.014	15	.048	.023	.076	.018
D umbel atrial macramphidisc						20	.043	.014	.068	.017	15	.042	.019	.068	.015
L dermal micramphidisc	15	.024	.016	.041	.006	15	.035	.022	.063	.011	15	.032	.023	.050	.008
L umbel dermal micramphidisc	15	.008	.005	.016	.003	15	.014	.009	.020	.003	15	.011	.007	.016	.003
D umbel dermal micramphidisc	15	.007	.005	.012	.002	15	.010	.006	.014	.002	15	.008	.005	.012	.002
L atrial micramphidisc	15	.025	.016	.032	.004	15	.027	.022	.041	.005	15	.026	.019	.032	.003
L umbel atrial micramphidisc	15	.007	.004	.010	.002	15	.010	.009	.013	.001	15	.009	.005	.013	.002
D umbel atrial micramphidisc	15	.007	.005	.008	.001	15	.009	.007	.012	.001	15	.007	.005	.009	.001

	HCL 47 (p4652)					HCL 330					HCL 47 (p1162)				
	n	avg	min	max	std	n	avg	min	max	std	n	avg	min	max	std
Length of the body		20					30					50			
Diameter of the body		30					35					60			
L dermalia pinular	25	.124	.106	.152	.012	25	.152	.114	.198	.021	15	.078	.053	.129	.019
L dermalia tangential	25	.119	.084	.167	.018	25	.132	.106	.167	.017	15	.059	.046	.076	.009
L atrialia pinular	25	.187	.106	.319	.056	25	.223	.137	.372	.065	18	.212	.099	.350	.085
L atrialia tangential	25	.079	.053	.106	.016	25	.124	.061	.182	.029	18	.111	.065	.426	.081
L dermal macramphidisc	15	.190	.167	.220	.017	19	.257	.205	.312	.024					
L umbel dermal macramphidisc	15	.063	.053	.076	.007	19	.086	.076	.106	.009					
D umbel dermal macramphidisc	15	.066	.053	.076	.006	19	.088	.068	.106	.011					
L atrial macramphidisc	10	.128	.099	.152	.019	25	.164	.057	.243	.056					
L umbel atrial macramphidisc	10	.046	.038	.053	.005	25	.057	.028	.084	.013					
D umbel atrial macramphidisc	10	.044	.038	.055	.005	25	.062	.034	.084	.014					
L dermal micramphidisc	18	.027	.018	.052	.008	15	.028	.016	.045	.007	15	.020	.014	.025	.003
L umbel dermal micramphidisc	18	.009	.005	.016	.003	15	.010	.007	.014	.002	15	.007	.005	.009	.001
D umbel dermal micramphidisc	18	.007	.005	.011	.002	15	.008	.007	.011	.001	15	.006	.005	.007	.001
L atrial micramphidisc	15	.028	.023	.043	.005	15	.026	.022	.031	.003	15	.023	.018	.032	.003
L umbel atrial micramphidisc	15	.010	.007	.013	.002	15	.009	.007	.011	.001	15	.008	.005	.012	.002
D umbel atrial micramphidisc	15	.007	.006	.009	.001	15	.008	.006	.009	.001	15	.007	.005	.010	.001

	HCL 337					HCL 321				
	n	avg	min	max	std	n	avg	min	max	std
Length of the body		100					150			
Diameter of the body		95					110	130		
L dermalia pinular	25	.166	.122	.243	.031	25	.150	.122	.220	.022
L dermalia tangential	25	.122	.072	.160	.020	25	.122	.084	.175	.020
L atrialia pinular	25	.161	.076	.236	.041	25	.172	.068	.486	.081
L atrialia tangential	25	.083	.046	.114	.016	25	.078	.038	.137	.025
L dermal macramphidisc	11	.175	.091	.251	.042					
L umbel dermal macramphidisc	11	.055	.034	.084	.016					
D umbel dermal macramphidisc	11	.051	.030	.076	.015					
L atrial macramphidisc	23	.154	.061	.213	.038	14	.122	.038	.175	.038
L umbel atrial macramphidisc	23	.056	.030	.068	.009	14	.053	.019	.076	.013
D umbel atrial macramphidisc	23	.052	.027	.061	.008	14	.048	.015	.068	.012
L dermal micramphidisc	15	.024	.014	.029	.004	15	.021	.018	.027	.003
L umbel dermal micramphidisc	15	.009	.005	.011	.001	15	.007	.005	.011	.001
D umbel dermal micramphidisc	15	.007	.005	.008	.001	15	.006	.005	.008	.001
L atrial micramphidisc	15	.024	.018	.031	.004	15	.021	.016	.024	.002
L umbel atrial micramphidisc	15	.008	.005	.011	.002	15	.007	.005	.010	.001
D umbel atrial micramphidisc	15	.006	.005	.010	.001	15	.006	.005	.008	.001

Source : MNHN, Paris

TABLE 26. — Some measurements of the spicules of holotype of *Pheronema giganteum*.

	holotype				
	n	avg	min	max	std
L dermalia pinular ray	25	.161	.068	.334	.077
L dermalia tangential ray	25	.053	.030	.084	.012
L atrialia pinular ray	25	.120	.076	.266	.051
L atrialia tangential ray	25	.052	.038	.068	.007
L microhexactin ray	25	.097	.061	.152	.023
L macramphidisc	25	.213	.167	.289	.026
L macramphidisc umbel	25	.075	.068	.084	.005
D macramphidisc umbel	25	.071	.053	.084	.007
L mesamphidisc	4	.041	.032	.054	.009
L mesamphidisc umbel	4	.020	.016	.027	.005
D mesamphidisc umbel	4	.020	.016	.032	.008
L micramphidisc	25	.029	.023	.041	.005
L micramphidisc umbel	25	.011	.007	.018	.002
D micramphidisc umbel	25	.008	.005	.012	.001

TABLE 27. — Some measurements of the spicules of holoype of *Pheronema pseudogiganteum*.

	original measures					IJIMA's data		
	n	avg	min	max	std	avg	min	max
L dermalia pinular ray	10	.081	.053	.114	.018		.085	.095
L dermalia tangential ray	10	.056	.042	.068	.007	70		
L atrialia pinular ray							.120	.250
L atrialia tangential ray								
L microhexactin ray	25	.263	.160	.456	.085		.300	.500
L macramphidisc	5	.242	.152	.289	.056		.170	.264
L macramphidisc umbel	5	.088	.068	.106	.016		.055	.065
D macramphidisc umbel	5	.103	.091	.114	.011		.650	.100
L micramphidisc	25	.023	.016	.083	.013		.020	.026
L micramphidisc umbel	25	.008	.005	.027	.004	.008		
D micramphidisc umbel	25	.008	.005	.020	.003	.008		
L micruncinate	12	.100	.076	.130	.017		.075	.125

TABLE 28. — Some measurements of the spicules of *Pheronema pseudogiganteum* forma *nuda*.

	HCL 358					HCL 359					HCL 360				
	n	avg	min	max	std	n	avg	min	max	std	n	avg	min	max	std
L dermalia pinular ray	25	.120	.076	.220	.034	15	.122	.068	.167	.029	25	.130	.061	.182	.026
L dermalia tangential ray	25	.060	.046	.091	.011	15	.071	.046	.114	.017	25	.088	.053	.152	.027
L atrialia pinular ray	25	.107	.084	.144	.017	0					0				
L atrialia tangential ray	25	.060	.030	.091	.014	0					0				
L microhexactin ray	25	.082	.054	.112	.015	15	.086	.046	.122	.022	25	.102	.068	.213	.028
L macramphidisc	25	.206	.175	.236	.016	11	.171	.152	.205	.016	25	.192	.152	.236	.023
L macramphidisc umbel	25	.068	.053	.084	.008	11	.062	.053	.076	.008	25	.067	.053	.084	.008
D macramphidisc umbel	25	.089	.076	.099	.007	11	.079	.061	.091	.009	25	.084	.061	.099	.009
L micramphidisc	25	.040	.032	.049	.004	15	.037	.031	.041	.004	24	.037	.027	.045	.004
L micramphidisc umbel	25	.013	.009	.016	.002	15	.010	.009	.013	.001	24	.011	.008	.014	.002
D micramphidisc umbel	25	.010	.008	.013	.001	15	.009	.007	.012	.001	24	.010	.007	.011	.001
L micruncinate	19	.058	.041	.077	.012	19	.063	.041	.117	.018	11	.062	.049	.074	.008

Source : MNHN, Paris

TABLE 29. — Some measurements of the spicules of *Pheronema pseudogiganteum* forma *vaubana*.

	HCL 363				
	n	avg	min	max	std
L dermalia pinular ray	25	.097	.068	.114	.010
L dermalia tangential ray	25	.059	.046	.084	.009
L atrialia pinular ray	25	.105	.084	.122	.012
L atrialia tangential ray	25	.068	.038	.114	.017
L microhexactin ray	25	.110	.076	.167	.020
L macramphidisc	25	.200	.167	.251	.018
L macramphidisc umbel	25	.067	.053	.076	.007
D macramphidisc umbel	25	.084	.068	.106	.008
L micramphidisc	25	.040	.029	.058	.008
L micramphidisc umbel	25	.012	.007	.018	.003
D micramphidisc umbel	25	.010	.007	.013	.001
L micruncinate	25	.078	.038	.182	.031

TABLE 30. — Some measurements of the spicules of *Pheronema pseudogiganteum* forma *stellata*.

	HCL 355					HCL 475					HCL 473				
	n	avg	min	max	std	n	avg	min	max	std	n	avg	min	max	std
L dermalia pinular ray	25	.131	.065	.190	.036	25	.072	.042	.137	.021	25	.140	.080	.198	.033
L dermalia tangential ray	25	.067	.034	.106	.019	25	.069	.042	.106	.016	25	.060	.034	.099	.020
L atrialia pinular ray	25	.384	.171	.555	.101	25	.202	.091	.277	.038	25	.354	.220	.490	.082
L atrialia tangential ray	25	.074	.042	.144	.022	25	.061	.042	.080	.010	25	.068	.038	.095	.016
L microhexactin ray	50	.072	.046	.095	.010	50	.072	.046	.106	.014	25	.069	.056	.092	.008
L macramphidisc	3	.206	.194	.224	.016	20	.192	.152	.228	.018	5	.198	.190	.205	.008
L macramphidisc umbel	3	.054	.049	.061	.006	20	.053	.042	.065	.007	5	.058	.053	.068	.007
D macramphidisc umbel	3	.100	.095	.106	.006	20	.093	.068	.110	.011	5	.102	.084	.106	.010
L mesamphidisc	25	.063	.043	.092	.014	23	.070	.050	.084	.008	25	.062	.034	.084	.012
L mesamphidisc umbel	25	.025	.013	.034	.005	23	.027	.015	.032	.004	25	.024	.016	.032	.004
D mesamphidisc umbel	25	.022	.013	.029	.004	23	.024	.012	.030	.004	25	.020	.013	.025	.004
L micramphidisc	16	.036	.025	.043	.006	18	.032	.020	.043	.007	25	.031	.023	.041	.005
L micramphidisc umbel	16	.012	.007	.014	.002	18	.011	.005	.018	.003	25	.011	.008	.014	.002
D micramphidisc umbel	16	.011	.008	.014	.002	18	.010	.005	.014	.002	25	.010	.007	.014	.002
L micruncinate	25	.069	.049	.099	.014	25	.083	.057	.118	.014					

	HCL 477				
L dermalia pinular ray	25	.120	.065	.163	.023
L dermalia tangential ray	25	.061	.038	.087	.013
L atrialia pinular ray	25	.163	.087	.239	.035
L atrialia tangential ray	25	.060	.042	.087	.011
L microhexactin ray	25	.130	.083	.198	.033
L macramphidisc	5	.198	.167	.228	.022
L macramphidisc umbel	5	.053	.046	.061	.005
D macramphidisc umbel	5	.101	.084	.118	.012
L mesamphidisc	25	.059	.041	.080	.011
L mesamphidisc umbel	25	.023	.015	.030	.004
D mesamphidisc umbel	25	.020	.013	.027	.004
L micramphidisc	25	.033	.027	.041	.004
L micramphidisc umbel	25	.012	.009	.014	.002
D micramphidisc umbel	25	.010	.007	.014	.001
L micruncinate	25	.065	.041	.099	.016

Source : MNHN, Paris

TABLE 31. — Some measurements of the spicules of *Pheronema pseudogiganteum* forma *variodisca*.

	HCL 364				
	n	avg	min	max	std
L dermalia pinular ray	25	.096	.068	.137	.017
L dermalia tangential ray	25	.059	.042	.080	.011
L atrialia pinular ray	25	.125	.091	.160	.020
L atrialia tangential ray	25	.090	.049	.144	.030
L microhexactin ray	25	.086	.057	.129	.018
L macramphidisc	25	.193	.137	.228	.022
L macramphidisc umbel	25	.060	.046	.076	.008
D macramphidisc umbel	25	.077	.053	.091	.009
L micramphidisc	1	.040	.040	.040	
L micramphidisc umbel	1	.013	.013	.013	
D micramphidisc umbel	1	.011	.011	.011	
L micruncinate	25	.046	.030	.084	.011

Source : MNHN, Paris

5

Crustacea Cirripedia Thoracica: Chionelasmatoidea and Pachylasmatoidea (Balanomorpha) of New Caledonia, Vanuatu and Wallis and Futuna Islands, with a review of all currently assigned taxa

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ABSTRACT

Balanomorph barnacles of the superfamilies Chionelasmatoidea and Pachylasmatoidea collected by various French deep-sea expeditions in the waters of New Caledonia, Vanuatu, and the Wallis and Futuna Islands are discussed. One sample from the Marianas Islands is also included. Of the 21 species reported herein, 18 are new to science, 2 are recognised as relictual, and 1 represents a northward range extension within the waters of the southwestern Pacific Ocean. In addition 4 new genera and 1 new subfamily are described. An exceptional diversity of species occurs in the subfamilies Pachylasmatinae and Hexelasmatinae of the family Pachylasmatidae. The number of new pachylasmatines described represents 46% of the known species and that of the new hexelasmatines 40%, indicating the richness of these waters. Of the 17 new species described from the waters of New Caledonia, Vanuatu, and the Wallis and Futuna Islands, 14 are considered presently to be endemic to the Vanuatu/New Caledonian region and the remaining 3 occur in a broader area which includes the Futuna and Wallis Islands region. The richest fauna occurs at the Loyalty Islands (15 species), the Norfolk Ridge (11 species) and New Caledonia (11 species). The occurrence of 2 relictual species, the chionelasmatine *Chionelasmus darwini* and the eolasmatine*Waikalasma boucheti*, in the waters of the New Caledonian region supports the hypothesis that the southwestern Pacific is a relictual area.

RÉSUMÉ

Crustacea Cirripedia Thoracica : Chionelasmatoidea et Pachylasmatoidea (Balanomorpha) de Nouvelle-Calédonie, du Vanuatu et des îles Wallis et Futuna, avec un examen de toutes les espèces reconnues actuellement.

Les cirripèdes balanomorphes des superfamilles Chionelasmatoidea et Pachylasmatoidea, récoltés par diverses expéditions françaises en eau profonde, au large de la Nouvelle-Calédonie, du Vanuatu et des îles Wallis et Futuna, sont

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Source : MNHN, Paris

étudiés. Une récolte provenant des îles Mariannes est également examinée. Des 21 espèces comprises dans ce travail, 18 sont nouvelles pour la Science, deux sont considérées comme des espèces reliques et une voit son aire de répartition accrue vers le Nord. En outre, quatre nouveaux genres et une nouvelle sous-famille sont décrits. Une diversité d'espèces exceptionnelle est rencontrée dans les sous-familles Pachylasmatinae et Hexelasmatinae de la famille Pachylasmatidae. Les nouvelles pachylasmatines décrites représentent 46% des espèces connues et celles des hexelasmatines 40%, ceci montrant bien la richesse des eaux prospectées. Sur les 17 espèces décrites des eaux de la Nouvelle-Calédonie, du Vanuatu et des îles Wallis et Futuna, 14 sont considérées actuellement comme endémiques de l'ensemble Nouvelle-Calédonie et Vanuatu; les trois restantes ont été trouvées dans une zone plus étendue incluant les îles Wallis et Futuna. Les faunes les plus riches se trouvent aux îles Loyauté (15 espèces), sur la ride de Norfolk (11 espèces) et en Nouvelle-Calédonie (11 espèces également). La présence, dans les eaux de la Nouvelle-Calédonie, de deux "fossiles vivants", le chionelasmatine *Chionelasmus darwini* et l'eolasmatine *Waikalasma boucheti*, renforce l'hypothèse que le Pacifique sud-ouest est une zone refuge.

INTRODUCTION

Since 1978 numerous specimens of balanomorph barnacles have been collected in the deep waters off Vanuatu (MUSORSTOM 8, 1994), New Caledonia, the Chesterfield and Loyalty Islands (*"Vauban"*, 1978-79; BIOCAL, 1985; MUSORSTOM 4, 1985; LAGON, 1984-89; MUSORSTOM 5, 1986; CHALCAL 2, 1986; SMIB 2, 1986; SMIB 3, 1987; CORAIL 2, 1988; MUSORSTOM 6, 1989; SMIB 6, 1990; BERYX 2, 1992; BATHUS 2, 1993; SMIB 8, 1993; HALIPRO 2, 1996), the Wallis and Futuna Islands, Combe, Field, Tuscarora and Waterwich Banks (MUSORSTOM 7, 1992), the Norfolk Ridge (SMIB 4, 1989; SMIB 5, 1989; BATHUS 3, 1993; BATHUS 4, 1994) and the Matthew and Hunter Islands (VOLSMAR, 1989).

Informations on the cruises where the samples studied here were collected can be found in RICHER DE FORGES, *et al.* (1988) for CORAIL 2; RICHER DE FORGES (1990) for *"Vauban"* 1978-79, BIOCAL, CHALCAL 2, MUSORSTOM 4, 5 and 6, SMIB 2, 3 and 4; RICHER DE FORGES (1991) for LAGON; RICHER DE FORGES (1993) for VOLSMAR, SMIB 5 and 6, BERYX 2; RICHER DE FORGES & MENOU (1993) for MUSORSTOM 7; RICHER DE FORGES, FALIEX & MENOU (1996) for MUSORSTOM 8; RICHER DE FORGE & CHEVILLON (1996) for BATHUS 2, 3 and 4, SMIB 8; GRANDPERRIN *et al.* (1997) for HALIPRO 2.

Examination of these collections has yielded an exceptional diversity of thoracican cirripeds. Of particular interest are the numerous specimens that are herein assigned to the balanomorph superfamily Pachylasmatoidea, especially within the pachylasmatine genus *Pachylasma* and the hexelasmatine genus *Hexelasma*, both of which are included in the family Pachylasmatidae. These specimens are reported on herein, together with specimens from the superfamily Chionelasmatoidea. A separate paper will report on the remaining balanomorph taxa collected by the above expeditions.

The Indo-Pacific deep-sea benthos was investigated by major expeditions such as those of *"Challenger"* (1873-1876), *"Investigator"* (1884-1887), *"Valdivia"* (1898-1899), *"Siboga"* (1899-1900), *"Albatross"* (1907-1910) and *"Galathea"* (1950-52). However, none of these expeditions collected Cirripedia in the waters of Vanuatu, New Caledonia or the Wallis and Futuna Islands. The cirriped fauna of the region is known from the brief report of FISCHER (1884), who described the shallow water barnacles of New Caledonia. More recently, BUCKERIDGE (1994) provided a comprehensive account of the deep-sea Verrucomorpha from collections made by several French cruises in the New Caledonia area and the Wallis and Futuna Islands, ROSS and NEWMAN (1995) described a new *Hoekiini* from the shallow waters of New Caledonia and BUCKERIDGE (1998) described a new chionelasmatine from the Norfolk Ridge.

The present paper includes the description of 23 new taxa — 1 new subfamily, 4 new genera and 18 new species. Also included are diagnoses and discussions of the previously reported species included in the Chionelasmatoidea and the Pachylasmatoidea. Thus, *in toto*, this account covers 1 family, 2 genera, 3 species and 2 subspecies of Chionelasmatoidea and, within the Pachylasmatoidea, 1 family, 5 subfamilies, 13 genera and 50 species. My evaluation of certain species suggests some are transferred into new genera, other are re-assigned elsewhere. The diagnosis of *Tetrapachylasma* Foster, 1988 is emended to reflect the intra-specific variation now

Source : MNHN, Paris

recognised within this genus. Wall structure in the Chionelasmatoidea and the Pachylasmatoidea is discussed in relation to balanomorph wall organisation. Endemism and species diversity, and the significance of antenniformy, reproductive state and regression and/or loss of the penis are also discussed.

Informations on the types of the species mentioned in this paper are supplied where possible. When a chapter "TYPES" is missing, no information was obtained for the species considered.

MATERIALS AND METHODS. — Specimens were examined with the aid of microscopy and dissection. Illustrations of the shell and whole animal were made with aid of a camera lucida. Soft parts were cleared, stained and mounted following the method of JONES (1993a) and mouthparts and appendages were drawn with a camera lucida. Measurements given are all in millimeters. The terminology follows that of NEWMAN (1987), JONES (1990) and YAMAGUCHI & NEWMAN (1990).

ABBREVIATIONS. — Institutions are abbreviated as follows:

AM: Australian Museum, Sydney, New South Wales, Australia;
AR: New Zealand Geological Survey Type Numbers, Auckland, New Zealand;
AU: Geology Department, University of Auckland, New Zealand;
BMNH: The Natural History Museum, London, U.K.;
GS: New Zealand Geological Survey, Auckland, New Zealand;
MNHN: Muséum national d'Histoire naturelle, Paris, France;
NIWA: National Institute of Water and Atmospheric Research, Wellington, New Zealand;
NMNZ: Museum of New Zealand, Wellington, New Zealand;
NZOI: New Zealand Oceanographic Institute, Wellington, New Zealand;
SOSC: Smithsonian Oceanographic Sorting Center, Washington, U.S.A.;
UMUT: University Museum of the University of Tokyo, Japan;
UPIBM: Invertebrate Museum of the Institute of Biology, College of Science, University of the Philippines;
USNM: National Museum of Natural History, Washington, D.C., U.S.A;
WAM: Western Australian Museum, Perth, Western Australia;
YPM: Peabody Museum of Natural History, Yale University, New Haven, CT., U.S.A.;
ZMC: Zoologisk Museum, Copenhagen, Denmark;
ZMUA: Zoölogisch Museum, Universiteit van Amsterdam, Holland.

Within the text the following abbreviations are used: **c.a.** for caudal appendage; **C** for carina, **CL** for carinolateral, **CL¹** for primary carinolateral, **CL²** for secondary carinolateral, **CI** to **CVI** for cirri I to VI; **LD** for lateral dimension; **m** for meter; **mls** for miles; **R** for rostrum, **RC** for rostro-carinal; **RL** for rostrolateral, **rg** for range; **S** for scutum; **T** for tergum; $\bar{x}$ for average.

In the lists of material examined the capital letters preceding the station numbers refer to the gear used: **BT** bottom trawl (large otter trawl for fishes); **CC** otter trawl (shrimps), **CH** otter trawl (fishes), **CP** beam trawl, **DE** epibenthic sledge, **DW** Waren dredge.

The acronyms for the cruises that collected the material reported on herein are as follows:

ANZARE = **A**ustralian and **N**ew **Z**ealand **A**ntarctic **R**esearch **E**xpedition, 1913;
BATHUS = the Greek Latinised name for deep;
BERYX = cruises on the seamounts around New Caledonia studying stocks of the fish ***Beryx***;
BIOCAL = **BIO**logie en Nouvelle **CAL**édonie (a trawling cruise);
CHALCAL = **CHAL**utages en Nouvelle **CAL**édonie (trawling cruises around New Caledonia);
CORAIL = cruises around the Chesterfield Islands which are in the **CORAIL** (Coral) Sea;
HALIPRO = **HALI**eutique **PRO**fonde (deep fisheries);
LAGON = **LAGON** de Nouvelle Calédonie (study of the benthos);
MUSORSTOM = a contraction of **MUS**éum (national d'Histoire naturelle) and **ORSTOM** (**O**ffice de la **R**echerche **S**cientifique et **T**echnique **O**utre-**M**er);
NAGA = the name of a mythical sea dragon.

Source : MNHN, Paris

SMIB = **S**ubstances **M**arine d'**I**ntérêt **B**iologique;
TUI = a New Zealand cruise of 1962 on board of the *"Tuiw"* a ship in the Royal New Zealand Navy. *Tui* is the vulgar tongue for a large passeriform bird, known also as the "Parson Bird".
"Vauban" = name of the ORSTOM research vessel working in New Caledonia from 1976 to 1988;
VOLSMAR = **VOL**cans **S**ous **MAR**ins (volcanoes under the sea).

TYPE SPECIES. — All holotypes of the new species are held by the MNHN and, when numbers of specimens available permit, paratypes by the WAM, the BMNH and the USNM.

REGISTRATION NUMBERS. — Due to computerisation of the WAM crustacean collection, starting from 1997, WAM crustacean registration numbers are preceded by C [e.g. WAM C 23243 for specimens of *Chionelasmus darwini* (Pilsbry, 1907) from SMIB 8: stn CP 180]. Prior to this date a different numbering system existed (e.g., WAM 261-96 for *C. darwini* from BATHUS 3: stn CP 812). MNHN registration numbers are prefixed by Ci and ZMUA registration numbers by Cirr, which refer to the respective cirriped collections. NMNZ registration numbers are prefixed by Cr and ZMC numbers by Cru, which refer to the respective crustacean collections. AM numbers prefixed by E refer to dry specimens and prefixed by P to wet (alcohol) specimens.
The samples without any registration number are kept at the Muséum national d'Histoire naturelle, Paris.

COMBINED LIST OF STATIONS AND OF SPECIES OBTAINED PER STATION

LAGON. **New Caledonia**.

Station 444. — 28.02.1985, 18°15'S, 162°59'E, 300-350 m: *Pachylasma ovatum* sp. nov.
Station 491. — 03.03.1985, 18°56'S, 163°20'E, 450 m: *Hexelasma sandaracum* sp. nov.

BIOCAL. **Loyalty Islands**.

Station DW 36. — 29.08.1985, 23°09'S, 167°11'E, 650-680 m: *Hexelasma sandaracum* sp. nov.
Station DW 44. — 30.08.1985, 22°47.3'S, 167°14.3'E, 440 m: *Eutomolasma maclaughlinae* sp. nov.
Station CP 45. — 30.08.1985, 22°47'S, 167°15'E, 430-465 m: *Eutomolasma maclaughlinae* sp. nov., *Hexelasma globosum* sp. nov.
Station DW 66. — 03.09.1985, 24°55'S, 168°22'E, 505-515 m: *Chionelasmus darwini* (Pilsbry), *Hexelasma persicum* sp. nov.
Station CP 67. — 03.09.1985, 24°55'S, 168°22'E, 500-510 m: *Chionelasmus darwini* (Pilsbry).
Station DW 83. — 06.09.1985, 20°35'S, 166°54'E, 460 m: *Eutomolasma orbiculatum* sp. nov.

MUSORSTOM 4. **New Caledonia**.

Station DW 156. — 15.09.1985, 18°54.0'S, 163°18.8'E, 525 m: *Hexelasma aureolum* sp. nov., *H. globosum* sp. nov., *H. sandaracum* sp. nov.
Station CP 157. — 15.09.1985, 18°52.5'S, 163°16.9'E, 575 m: *Hexelasma sandaracum* sp. nov.
Station DW 159. — 15.09.1985, 18°45.9'S, 163°15.6'E, 585 m: *Hexelasma persicum* sp. nov., *H. sandaracum* sp. nov.
Station CP 167. — 16.09.1985, 18°35.8'S, 163°06.4'E, 575 m: *Hexelasma globosum* sp. nov., *H. sandaracum* sp. nov.
Station CP 169. — 17.09.1985, 18°54.3'S, 163°11.2'E, 590 m: *Hexelasma sandaracum* sp. nov.
Station CP 170. — 17.09.1985, 18°57.0'S, 163°12.6'E, 460 m: *Eutomolasma maclaughlinae* sp. nov., *Hexelasma sandaracum* sp. nov.
Station CP 178. — 18.09.1985, 18°56.3'S, 163°12.9'E, 520 m: *Hexelasma sandaracum* sp. nov.
Station CP 179. — 18.09.1985, 18°56.6'S, 163°13.7'E, 475 m: *Eutomolasma maclaughlinae* sp. nov., *Hexelasma persicum* sp. nov.
Station DW 183. — 18.09.1985, 19°01.8'S, 163°25.8'E, 280 m: *Eutomolasma maclaughlinae* sp. nov.

Source : MNHN, Paris

Station CP 190. — 19.09.1985, 19°06'S, 163°29.50'E, 215 m: *Pachylasma laeviscutum* sp. nov.
Station CP 193. — 19.09.1985, 18°56.3'S, 163°23.2'E, 415 m: *Pachylasma ovatum* sp. nov.
Station CP 194. — 19.09.1985, 18°52.8'S, 163°21.7'E, 545 m: *Hexelasma sandaracum* sp. nov.
Station CP 197. — 20.09.1985, 18°51.3'S, 163°21.0'E, 550 m: *Hexelasma globosum* sp. nov., *H. persicum* sp. nov., *H. sandaracum* sp. nov.
Station DW 215. — 28.09.1985, 22°55.7'S, 167°17.0'E, 485-520 m: *Eutomolasma maclaughlinae* sp. nov.
Station DW 221. — 29.09.1985, 22°58.60'S, 167°36.80'E, 535-560 m: *Eutomolasma maclaughlinae* sp. nov.
Station DW 222. — 30.09.1985, 22°57.6'S, 167°33.0'E, 410-440 m: *Eutomolasma maclaughlinae* sp. nov., *Hexelasma persicum* sp. nov.
Station DW 223. — 30.09.1985, 22°57.0'S, 167°30.0'E, 545-560 m: *Eutomolasma maclaughlinae* sp. nov., *Hexelasma persicum* sp. nov.
Station DW 229. — 30.09.1985, 22°51.5'S, 167°13.5'E, 445-460 m: *Eutomolasma maclaughlinae* sp. nov.
Station DW 230. — 30.09.1985, 22°52.5'S, 167°11.8'E, 390-420 m: *Eutomolasma maclaughlinae* sp. nov., *Pachylasma laeviscutum* sp. nov.
Station CP 238. — 02.10.1985, 22°13.0'S, 167°14.0'E, 500-510 m: *Chionelasmus darwini* (Pilsbry), *Hexelasma aureolum* sp. nov.

SMIB 2. **Norfolk Ridge**.

Station DW 1. — 17.09.1986, 22°53'S, 167°13'E, 438-444 m: *Eutomolasma maclaughlinae* sp. nov.
Station DW 2. — 17.09.1986, 22°55'S, 167°14'E, 438-448 m: *Eutomolasma maclaughlinae* sp. nov.
Station DW 12. — 18.09.1986, 22°53'S, 167°14'E, 445-460 m: *Eutomolasma maclaughlinae* sp. nov.

MUSORSTOM 5. **Chesterfield Islands**.

Station DW 255. — 07.10.1986, 25°15.40'S, 159°54.80'E, 280-295 m: *Tetrapachylasma arcuatum* sp. nov.
Station DW 301. — 12.10.1986, 22°06.90'S, 159°24.60'E, 487-610 m: *Tetrapachylasma arcuatum* sp. nov.
Station DW 304. — 12.10.1986, 22°10.34'S, 159°25.51'E, 385-420 m: *Tetrapachylasma arcuatum* sp. nov.
Station DW 338. — 15.10.1986, 19°51.6'S, 158°40.40'E, 540-580 m: *Hexelasma aureolum* sp. nov., *H. persicum* sp. nov.
Station DC 388. — 22.10.1986, 20°45.35'S, 160°53.69'E, 500-510 m: *Eutomolasma maclaughlinae* sp. nov.
Station CP 389. — 22.10.1986, 20°44.95'S, 160°53.67'E, 500 m: *Hexelasma aureolum* sp. nov.

CHALCAL 2. **Norfolk Ridge**.

Station CC 1. — 28.10.1986, 24°54.96'S, 168°21.91'E, 500 m: *Chionelasmus darwini* (Pilsbry).
Station CC 2. — 28.10.1986, 24°55.48'S, 168°21.29'E, 500 m: *Chionelasmus darwini* (Pilsbry).
Station CH 4. — 27.10.1986, 24°44.31'S, 168°09.32'E, 253 m: *Tetrapachylasma arcuatum* sp. nov.
Station CH 9. — 31.10.1986, 23°15.64'S, 168°03.06'E, 300 m: *Hexelasma persicum* sp. nov.
Station CP 21. — 28.10.1986, 24°54.00'S, 168°21.61'E, 500 m: *Chionelasmus darwini* (Pilsbry).
Station DW 72. — 28.10.1986, 24°54.5'S, 168°22.3'E, 527 m: *Hexelasma aureolum* sp. nov.
Station DW 74. — 29.10.1986, 24°40.36'S, 168°38.39'E, 650 m: *Chionelasmus darwini* (Pilsbry).
Station DW 75. — 29.10.1986, 24°39.31'S, 168°39.67'E, 600 m: *Chionelasmus darwini* (Pilsbry).
Station DW 76. — 30.10.1986, 23°40.50'S, 167°45.20'E, 470 m: *Chionelasmus darwini* (Pilsbry), *Hexelasma aureolum* sp. nov.
Station DW 77. — 30.10.1986, 23°38.35'S, 167°42.68'E, 435 m: *Chionelasmus darwini* (Pilsbry).

SMIB 3. **Norfolk Ridge**.

Station DW 5. — 21.05.1987, 24°55'S, 168°22'E, 502-512 m: *Hexelasma aureolum* sp. nov.
Station DW 21. — 24.05.1987, 22°59'S, 167°19'E, 525 m: *Eutomolasma maclaughlinae* sp. nov.
Station DW 22. — 24.05.1987, 23°03'S, 167°19'E, 503 m: *Eutomolasma maclaughlinae* sp. nov.
Station DW 24. — 24.05.1987, 22°59'S, 167°19'E, 525 m: *Chionelasmus darwini* (Pilsbry), *Eutomolasma maclaughlinae* sp. nov.

Source : MNHN, Paris

Station DW 25. — 24.05.1987, 22°56'S, 167°16'E, 437 m: *Eutomolasma maclaughlinae* sp. nov.
Station DW 27. — 24.05.1987, 22°55'S, 167°16'E, 457 m: *Eutomolasma maclaughlinae* sp. nov.

CORAIL 2. **Chesterfield Islands**.

Station DE 16. — 21.07.1988, 20°47.75'S, 160°55.87'E, 500 m: *Hexelasma aureolum* sp. nov.
Station CP 17. — 21.09.1988, 20°48.14'S, 160°57.14'E, 500 m: *Hexelasma aureolum* sp. nov.

MUSORSTOM 6. **Loyalty Islands/Loyalty Ridge**.

Station DW 400. — 14.02.1989, 20°42.18'S, 167°00.40'E, 270 m: *Hexelasma foratum* sp. nov.
Station CP 401. — 14.02.1989, 20°42.15'S, 167°00.35'E, 270 m: *Pachylasma bacum* sp. nov., *Hexelasma sandaracum* sp. nov.
Station DW 407. — 15.02.1989, 20°40.70'S, 167°06.60'E, 360 m: *Tetrapachylasma arcuatum* sp. nov.
Station DW 421. — 16.02.1989, 20°26.27'S, 166°40.17'E, 245 m: *Microlasma fragile* sp. nov.
Station DW 422. — 16.02.1989, 20°26.20'S, 166°40.31'E, 257 m: *Hexelasma aureolum* sp. nov.
Station DW 424. — 17.02.1989, 20°24.30'S, 166°24.70'E, 599 m: *Hexelasma sandaracum* sp. nov.
Station DW 451. — 20.02.1989, 20°59.00'S, 167°24.50'E, 330 m: *Hexelasma foratum* sp. nov.
Station DW 460. — 20.02.1989, 21°01.70'S, 167°31.45'E, 420 m: *Metalasma crassum* sp. nov., *Hexelasma aureolum* sp. nov.
Station CP 465. — 21.02.1989, 21°03.55'S, 167°32.55'E, 480 m: *Eutomolasma maclaughlinae* sp. nov.
Station CP 466. — 21.02.1989, 21°05.25'S, 167°32.2'E, 540 m: *Eutomolasma maclaughlinae* sp. nov.
Station CP 467. — 21.02.1989, 21°05.13'S, 167°32.11'E, 575 m: *Eutomolasma maclaughlinae* sp. nov.
Station CC 470. — 21.02.1989, 21°04.40'S, 167°33.20'E, 560 m: *Hexelasma sandaracum* sp. nov.
Station CP 471. — 22.02.1989, 21°08.00'S, 167°54.10'E, 460 m: *Tetrapachylasma arcuatum* sp. nov., *Hexelasma sandaracum* sp. nov.
Station DW 472. — 22.02.1989, 21°08.60'S, 167°54.70 E, 300 m: *Tetrapachylasma arcuatum* sp. nov., *Hexelasma flavidum* sp. nov.
Station DW 476. — 22.02.1989, 21°09.36'S, 167°56.40'E, 300 m: *Metalasma crassum* sp. nov., *Hexelasma aureolum* sp. nov.
Station DW 478. — 22.02.1989, 21°08.96'S, 167°54.28'E, 400 m: *Eurylasma angustum* sp. nov., *Tetrapachylasma arcuatum* sp. nov., *Metalasma crassum* sp. nov., *Hexelasma aureolum* sp. nov., *H. persicum* sp. nov.
Station DW 479. — 22.02.1989, 21°09.13'S, 167°54.95'E, 310 m: *Metalasma crassum* sp. nov.
Station DW 483. — 23.02.1989, 21°19.80'S, 167°47.80'E, 600 m: *Hexelasma sandaracum* sp. nov.
Station DW 486. — 23.02.1989, 20°21.40'S, 167°47.65'E, 370 m: *Hexelasma globosum* sp. nov.

SMIB 4. **Norfolk Ridge**.

Station DW 44. — 08.03.1989, 24°46.0'S, 168°08.2'E, 300 m: *Hexelasma sandaracum* sp. nov.
Station DW 55. — 09.03.1989, 23°21.4'S, 168°04.5'E, 260 m: *Chionelasmus darwini* (Pilsbry), *Eutomolasma orbiculatum* sp. nov.
Station DW 58. — 09.03 1989, 22°59.8'S, 167°24.2'E, 560 m: *Eutomolasma maclaughlinae* sp. nov.
Station DW 60. — 10.03.1989, 22°00.1'S, 167°21.6'E, 535 m: *Hexelasma sandaracum* sp. nov.
Station DW 61. — 10.03.1989, 22°59.9'S, 167°22.8'E, 550 m: *Eutomolasma maclaughlinae* sp. nov., *Hexelasma aureolum* sp. nov.
Station DW 62. — 10.03.1989, 23°00.4'S, 167°21.8'E, 540 m: *Hexelasma sandaracum* sp. nov.
Station DW 63. — 10.03.1989, 22°58.7'S, 167°21.1'E, 520 m: *Hexelasma sandaracum* sp. nov.
Station DW 64. — 10.03.1989, 22°55.3'S, 167°16.4'E, 460 m: *Eutomolasma maclaughlinae* sp. nov., *Hexelasma sandaracum* sp. nov.
Station DW 65. — 10.03.1989, 22°55.3'S, 167°14.5'E, 420 m: *Eutomolasma maclaughlinae* sp. nov.
Station DW 68. — 10.03.1989, 22°55.0'S, 167°16.0'E, 440 m: *Eutomolasma maclaughlinae* sp. nov., *E. orbiculatum* sp. nov.

Source : MNHN, Paris

VOLSMAR. **New Hebrides Arc.**

Station DW 16. — 03.06.1989, 22°25.1'S, 171°40.7'E, 500 m: *Tetrapachylasma arcuatum* sp. nov., *Metalasma crassum* sp. nov., *Hexelasma foratum* sp. nov.

SMIB 5. **Norfolk Ridge.**

Station DW 71. — 07.09.1989, 23°41.3'S, 168°00.7'E, 265 m: *Eurylasma pyramidale* sp. nov.
Station DW 75. — 07.09.1989, 23°40.9'S, 168°00.8'E, 270 m: *Eurylasma pyramidale* sp. nov.
Station DW 85. — 13.09.1989, 22°20.0'S, 163°42.9'E, 260 m: *Pachylasma laeviscutum* sp. nov.
Station DW 87. — 13.09.1989, 22°18.7'S, 168°41.3'E, 370 m: *Tetrapachylasma arcuatum* sp. nov., *Hexelasma flavidum* sp. nov.
Station DW 88. — 13.09.1989, 22°18.6'S, 168°40.2'E, 350 m: *Pachylasma laeviscutum* sp. nov.
Station DW 93. — 13.09.1989, 22°20.0'S, 168°42.3'E, 255 m: *Eurylasma pyramidale* sp. nov., *Tetrapachylasma arcuatum* sp. nov., *Hexelasma flavidum* sp. nov.
Station DW 94. — 13.09.1989, 22°19.6'S, 168°42.8'E, 275 m: *Eurylasma pyramidale* sp. nov., *Hexelasma persicum* sp. nov.
Station DW 101. — 14.09.1989, 23°21.2'S, 168°04.9'E, 270 m: *Eurylasma pyramidale* sp. nov.

BERYX 2. **New Caledonia.**

Station DW 34. — 19.10.1992, 23°33'S, 167°17'E, 560-570 m: *Hexelasma sandaracum* sp. nov.
Station DW 35. — 19.10.1992, 23°33'S, 167°16'E, 550-570 m: *Hexelasma sandaracum* sp. nov.
Station DW 38. — 19.10.1992, 23°38'S, 167°39'E, 550-690 m: *Hexelasma sandaracum* sp. nov.
Station CP 46. — 20.10.1992, 23°42'S, 168°01'E, 300-350 m: *Hexelasma persicum* sp. nov.

MUSORSTOM 7. **Wallis and Futuna Islands, Combe, Field, Tuscarora and Waterwich Banks.**

Station CP 505. — 11.05.1992, 14°19'S, 178°04'W, 245-400 m: *Eutomolasma maclaughlinae* sp. nov.
Station CP 508. — 11.05.1992, 14°20'S, 178°06'W, 245-440 m: *Pachylasma laeviscutum* sp. nov.
Station CP 515. — 12.05.1992, 14°13'S, 178°10'W, 224-252 m: *Pachylasma laeviscutum* sp. nov.
Station DW 522. — 13.05.1992, 13°11'S, 176°15'W, 650-765 m: *Hexelasma sandaracum* sp. nov.
Station DW 537. — 16.05.1992, 12°30'S, 176°41'W, 325-400 m: *Eutomolasma maclaughlinae* sp. nov.
Station DW 539. — 17.05.1992, 12°27'S, 177°27'W, 700 m: *Hexelasma sandaracum* sp. nov.
Station DW 547. — 17.05.1992, 14°20'S, 178°06'W, 455 m: *Eutomolasma maclaughlinae* sp. nov.
Station DW 559. — 19.05.1992, 11°48'S, 178°19'W, 547-552 m: *Hexelasma sandaracum* sp. nov.
Station DW 582. — 22.05.1992, 13°10'S, 176°14'W, 360 m: *Hexelasma sandaracum* sp. nov.
Station DW 586. — 22.05.1992, 13°11'S, 178°11'W, 510-600 m: *Hexelasma sandaracum* sp. nov.
Station CP 622. — 28.05.1992, 12°34'S, 178°11'W, 1280-1300 m: *Hexelasma persicum* sp. nov.

SMIB 8. **New Caledonia.**

Station DW 150. — 27.01.1993, 24°54.3'S, 168°22.2'E, 519-530 m: *Hexelasma aureolum* sp. nov.
Station DW 167. — 29.01.1993, 23°38.1'S, 168°43.1'E, 430-452 m: *Eutomolasma maclaughlinae* sp. nov.
Station CP 180. — 30.01.1993, 23°47.7'S, 168°18.1'E, 425-460 m: *Chionelasmus darwini* (Pilsbry), *Hexelasma persicum* sp. nov.
Station DW 185. — 31.01.1993, 23°16'S, 168°04.3'E, 305-355 m: *Hexelasma persicum* sp. nov.
Station DW 189. — 31.01.1993, 23°17.6'S, 168°05.5'E, 400-402 m: *Hexelasma sandaracum* sp. nov.
Station DW 193. — 01.02.1993, 22°58.7'S, 168°20.1'E, 500-508 m: *Hexelasma persicum* sp. nov.
Station DW 194. — 01.02.1993, 22°59.6'S, 168°22.5'E, 491 m: *Hexelasma persicum* sp. nov.
Station DW 197. — 01.02.1993, 22°51.3'S, 168°12.5'E, 414-436 m: *Eutomolasma maclaughlinae* sp. nov.
Station DW 198. — 01.02.1993, 22°51.6'S, 167°12.4'E, 414-430 m: *Eutomolasma maclaughlinae* sp. nov.
Station DW 199. — 01.02.1993, 22°51.6'S, 168°12.22'E, 408-410 m: *Eutomolasma maclaughlinae* sp. nov.

Source : MNHN, Paris

BATHUS 2. **New Caledonia**.

Station DW 718. — 11.05.1993, 22°46.70'S, 167°14.45'E, 430-436 m: *Eutomolasma maclaughlinae* sp. nov.
Station DW 719. — 11.05.1993, 22°47.57'S, 167°14.58'E, 444-455 m: *Eutomolasma maclaughlinae* sp. nov.
Station DW 720. — 11.05.1993, 22°51.62'S, 167°16.40'E, 530-541 m: *Eutomolasma maclaughlinae* sp. nov.
Station DW 729. — 12.05.1993, 22°52.42'S, 167°11.90'E, 400 m: *Eutomolasma maclaughlinae* sp. nov., *Hexelasma sandaracum* sp. nov.
Station DW 738. — 13.05.1993, 23°02.09'S, 166°56.61'E, 588-647 m: *Eutomolasma maclaughlinae* sp. nov.

BATHUS 3. **Norfolk Ridge, Loyalty Ridge**.

Station DW 778. — 24.11.1993, 24°43'S, 170°07'E, 750-760 m: *Waikalasma boucheti* Buckeridge.
Station CP 805. — 27.11.1993, 23°41'S, 168°01'E, 278-310 m: *Eurylasma pyramidale* sp. nov.
Station DW 809. — 27.11.1993, 23°39'S, 167°59'E, 650-730 m: *Hexelasma aureolum* sp. nov.
Station DW 811. — 28.11.1993, 23°41'S, 168°15'E, 383-408 m: *Hexelasma sandaracum* sp. nov.
Station CP 812. — 28.11.1993, 23°43.38'S, 168°15.98'E, 391-440 m: *Chionelasmus darwini* (Pilsbry).
Station CP 815. — 28.11.1993, 23°47'S, 168°16'E, 460-470 m: *Chionelasmus darwini* (Pilsbry), *Eurylasma ferulum* sp. nov.
Station DW 818. — 28.11.1993, 23°44'S, 168°16'E, 394-401 m: *Hexelasma persicum* sp. nov.
Station DW 819. — 28.11.1993, 23°45'S, 168°16'E, 478-486 m: *Hexelasma aureolum* sp. nov.
Station CH 820. — 28.11.1993, 23°43'S, 168°16'E, 405-411 m: *Hexelasma persicum* sp. nov.
Station DW 829. — 29.11.1993, 23°21'S, 168°02'E, 386-390 m: *Eutomolasma maclaughlinae* sp. nov.
Station DW 830. — 29.11.1993, 23°20'S, 168°01'E, 361-365 m: *Hexelasma persicum* sp. nov., *Eurylasma pyramidale* sp. nov.
Station CP 833. — 30.11.1993, 23°03'S, 168°58'E, 441-444 m: *Eutomolasma maclaughlinae* sp. nov.

BATHUS 4. **New Caledonia, Norfolk Ridge**.

Station CP 909. — 14.08.1994, 18°57.64'S, 163°10.30'E, 516-558 m: *Eutomolasma maclaughlinae* sp. nov.
Station CP 910. — 05.08.1994, 16°69.32'S, 163°08.47'E, 560-608 m: *Hexelasma flavidum* sp. nov., *H. sandaracum* sp. nov.
Station CP 911. — 05.08.1994, 18°58'S, 163°09'E, 558-566 m: *Hexelasma sandaracum* sp. nov.
Station DW 914. — 05.08.1994, 18°48.79'S, 163°15.23'E, 600-616 m: *Pachylasma ovatum* sp. nov.
Station DW 916. — 05.08.1994, 18°53.30'S, 163°19.55'E, 600-616 m: *Hexelasma sandaracum* sp. nov.
Station DW 923. — 06.08.1994, 18°51.51'S, 163°24.17'E, 470-502 m: *Hexelasma sandaracum* sp. nov.
Station DW 924. — 07.08.1994, 18°54.85'S, 163°24.34'E, 344-360 m: *Pachylasma ovatum* sp. nov.
Station DW 927. — 07.08.1994, 18°55.48'S, 163°22.11'E, 452-444 m: *Hexelasma sandaracum* sp. nov.
Station DW 928. — 07.08.1994, 18°55'S, 163°24'E, 420-452 m: *Hexelasma sandaracum* sp. nov.
Station DW 929. — 07.08.1994, 18°51.55'S, 163°23.27'E, 502-516 m: *Hexelasma persicum* sp. nov., *H. sandaracum* sp. nov.
Station DW 932. — 08.08.1994, 19°07.91'S, 163°29.38'E, 170-190 m: *Hexelasma sandaracum* sp. nov.
Station CP 951. — 10.08.1994, 20°31.44'S, 164°54.97'E, 960 m: *Hexelasma sandaracum* sp. nov.

MUSORSTOM 8. **Vanuatu**.

Station CP 962. — 21.09.1994, 20°19.70'S, 169°49.02'E, 370-400 m: *Pachylasma laeviscutum* sp. nov.
Station CP 963. — 21.09.1994, 20°20.10'S, 169°49.08'E, 400-440 m: *Pachylasma laeviscutum* sp. nov., *Tetrapachylasma arcuatum* sp. nov.
Station DW 967. — 21.09.1994, 20°19.45'S, 169°52.87'E, 295-334 m: *Eurylasma angustum* sp. nov.
Station CP 972. — 22.09.1994, 19°21.94'S, 169°28.07'E, 487-507 m: *Hexelasma sandaracum* sp. nov.
Station CP 973. — 22.09.1994, 19°21.30'S, 169°27.03'E, 460-480 m: *Hexelasma sandaracum* sp. nov.
Station CP 974. — 22.09.1994, 19°21.51'S, 169°28.26'E, 492-520 m: *Hexelasma sandaracum* sp. nov.
Station DW 978. — 22.09.1994, 19°22.62'S, 169°27.11'E, 413-408 m: *Hexelasma sandaracum* sp. nov.

Source : MNHN, Paris

Station DW 988. — 23.09.1994, 19°16.04'S, 169°24.12'E, 372-466 m: *Pachylasma laeviscutum* sp. nov.
Station DW 989. — 23.09.1994, 19°13.92'S, 169°20.25'E, 650-669 m: *Hexelasma sandaracum* sp. nov.
Station CP 1026. — 28.09.1994, 17°50.35'S, 168°39.33'E, 437-504 m: *Hexelasma sandaracum* sp. nov.
Station CP 1027. — 28.09.1994, 17°53.05'S, 168°39.35'E, 550-571 m: *Hexelasma sandaracum* sp. nov.
Station CP 1045. — 30.09.1994, 15°57.63'S, 166°38.43'E, 459-488 m: *Hexelasma sandaracum* sp. nov.
Station DW 1046. — 30.09.1994, 16°53.62'S, 168°11.08'E, 461-480 m: *Hexelasma sandaracum* sp. nov.
Station DW 1060. — 02.10.1994, 16°13.82'S, 167°20.80'E, 375-397 m: *Eurylasma angustum* sp. nov.
Station DW 1062. — 02.10.1994, 16°14.82'S, 167°18.64'E, 619-658 m: *Bathylasma alearum* sp. nov.
Station DW 1067. — 02.10.1994, 16°16.78'S, 167°21.52'E, 344-366 m: *Hexelasma sandaracum* sp. nov.
Station CP 1080. — 05.09.1994, 15°57.30'S, 167°27.73'E, 799-850 m: *Hexelasma sandaracum* sp. nov.
Station CP 1083. — 05.10.1994, 15°51.91'S, 167°19.42'E, 397-439 m: *Hexelasma sandaracum* sp. nov.
Station CP 1086. — 05.10.1994, 15°36.58'S, 167°16.32'E, 182-215 m: *Pachylasma bacum* sp. nov.
Station CP 1114. — 08.10.1994, 14°52.39'S, 167°03.40'E, 647 m: *Hexelasma sandaracum* sp. nov.
Station CP 1125. — 10.10.1994, 15°57.63'S, 166°38.43'E, 1160-1220 m: *Hexelasma sandaracum* sp. nov.
Station CP 1127. — 10.10.1994, 15°58.86'S, 166°37.82'E, 1052-1058 m: *Hexelasma sandaracum* sp. nov.
Station CP 1131. — 11.10.1994, 15°38.41'S, 167°03.52'E, 140-175 m: *Pachylasma laeviscutum* sp. nov.
Station CP 1136. — 11.10.1994, 15°40.62'S, 167°01.60'E, 398-400 m: *Hexelasma sandaracum* sp. nov.

HALIPRO 2. **New Caledonia.**

Station BT 49. — 16.11.1996, 25°23.66'S, 168°19.62'E, 605-628 m: *Chionelasmus darwini* (Pilsbry).
Station BT 70. — 20.11.1996, 24°42.96'S, 168°08.17'E, 226-238 m: *Tetrapachylasma arcuatum* sp. nov.
Station BT 71. — 20.11.1996, 24°50.12'S, 168°09.97'E, 820-1220 m: *Tetrapachylasma arcuatum* sp. nov.

LIST OF SPECIES DESCRIBED OR DISCUSSED HEREIN

† = fossil species

CHIONELASMATOIDEA

Family CHIONELASMATIDAE

Genus ***EOCHIONELASMUS***
Eochionelasmus ohtai Yamaguchi, 1990

Genus ***CHIONELASMUS***
Chionelasmus crosnieri Buckeridge, 1998
Chionelasmus darwini (Pilsbry, 1907)
Chionelasmus darwini darwini (Pilsbry, 1907)
Chionelasmus darwini cantelli Yamaguchi, 1998

PACHYLASMATOIDEA

Family PACHYLASMATIDAE

Subfamily EOLASMATINAE

Genus ***EOLASMA***
†*Eolasma maxwelli* Buckeridge, 1983
†*Eolasma rugosa* Buckeridge, 1985

Genus ***WAIKALASMA***
Waikalasma boucheti Buckeridge, 1996
†*Waikalasma juneae* Buckeridge, 1983

Subfamily PACHYLASMATINAE

Genus ***EUTOMOLASMA*** gen. nov.
Eutomolasma chinense (Pilsbry, 1912)
Eutomolasma japonicum (Hiro, 1933)
Eutomolasma maclaughlinae sp. nov.
Eutomolasma orbiculatum sp. nov.

Genus ***MICROLASMA*** gen. nov.
Microlasma arwetergum (Rosell, 1991)
Microlasma crinoidophilum (Pilsbry, 1911)
Microlasma fragile sp. nov.
Microlasma ochriderma (Foster, 1981)

Genus ***PACHYLASMA***
Pachylasma bacum sp. nov.
Pachylasma darwinianum (Pilsbry, 1912)
Pachylasma ecaudatum Hiro, 1939
Pachylasma giganteum (Philippi, 1836)
Pachylasma integrirostrum Broch, 1931
Pachylasma laeviscutum sp. nov.
Pachylasma ovatum sp. nov.
Pachylasma scutistriata Broch, 1922

Source : MNHN, Paris

Genus ***EURYLASMA*** gen. nov.
Eurylasma angustum sp. nov.
Eurylasma ferulum sp. nov.
Eurylasma pyramidale sp. nov.

Genus ***TETRAPACHYLASMA***
Tetrapachylasma arcuatum sp. nov.
Tetrapachylasma aurantiacum (Darwin, 1854)
Tetrapachylasma ferrugomaculosa (Jones, 1993)
Tetrapachylasma ornatum sp. nov.
Tetrapachylasma trigonum Foster, 1988

Subfamily METALASMATINAE subfam. nov.

Genus ***METALASMA*** gen. nov.
Metalasma crassum sp. nov.

Subfamily BATHYLASMATINAE

Genus ***BATHYLASMA***
Bathylasma alearum (Foster, 1978)
†*Bathylasma aucklandicum* (Hector, 1888)
Bathylasma corolliforme (Hoek, 1883)
Bathylasma hirsutum (Hoek, 1883)

Genus ***MESOLASMA***
Mesolasma fosteri (Newman & Ross, 1971)

Genus ***TETRACHAELASMA***
Tetrachaelasma southwardi Newman & Ross, 1971

Genus ***TESSARELASMA***
†*Tessarelasma pilsbryi* Withers, 1936

Subfamily HEXELASMATINAE

Genus ***HEXELASMA***
Hexelasma americanum Pilsbry, 1916
Hexelasma arafurae Hoek, 1913
Hexelasma aureolum sp. nov.
Hexelasma brintoni (Newman & Ross, 1971)
Hexelasma callistoderma Pilsbry, 1911
Hexelasma flavidum sp. nov.
Hexelasma foratum sp. nov.
Hexelasma globosum sp. nov.
Hexelasma gracilis Foster, 1981
Hexelasma leptoderma Newman & Ross, 1971
Hexelasma nolearia (Foster, 1978)
Hexelasma persicum sp. nov.
Hexelasma sandaracum sp. nov.
Hexelasma triderma Newman & Ross, 1971
Hexelasma velutinum Hoek, 1913

WALL ORGANISATION IN THE BALANOMORPHA

In the systematics of balanomorph barnacles the number of wall plates and the manner in which they articulate or coalesce to one another are of major importance. In early balanomorphs the wall was surrounded by one or more whorls of smaller imbricating plates that protect the suture between the base of the primary wall and the substratum, and the lower portion of the sutures between the wall plates (BUCKERIDGE & NEWMAN, 1992; NEWMAN, 1993). In most Tertiary forms the imbricating plates are lost and significant concomitant changes appear in the structure of the compartments themselves (e.g., the development of alae and radii), the number of wall plates and in the way these articulate or coalesce with one another.

The phylogeny of the balanomorphs indicates that various plates have been added to the wall, with 8 being the maximum complement in a few surviving early forms. This is repeated in their ontogeny to a remarkable extent. However, the general pattern is one of reduction, from 8-plated forms to 6-plated forms, of which some derived forms independently went to 4 plates.

Although the 4 plates seen in derived forms have evolved through reduction by elimination or coalescence, current concepts on the evolution, ontogeny and homologies of the wall plates in balanomorphs indicate that 4 plates are the basic number (ROSS & NEWMAN, 1996). Since DARWIN (1854) the primitive 8-plated wall in balanomorphs such as *Catophragmus* s. l., *Pachylasma, Octomeris* and *Chelonibia* has been considered to consist of R-RL-L-CL-C with CL overlapping C and underlapped by L. The 6-plated balanomorph wall (R-L-CL-C) was considered to be a reduction from 8 plates, due to the development of a tripartite or compound rostrum (RL+R+RL). Early in the ontogeny of all balanomorph barnacles, however, the wall consists of only 4 plates, R, L, and C (DARWIN, 1854; GLENNER & HØEG, 1993). YAMAGUCHI & NEWMAN (1990) consider this 4-plated wall to have also been the case in balanomorph phylogeny and these and subsequent authors have provided evidence that the so-called "median-latus" (L) is actually the CL, as L was incorporated into the operculum and subsequently lost (YAMAGUCHI & NEWMAN, 1990; BUCKERIDGE & NEWMAN, 1992; NEWMAN, 1993). Therefore, the basic balanomorph wall should be designated R-CL-C (rather than R-L-C) with CL overlapping C and R.

Source : MNHN, Paris

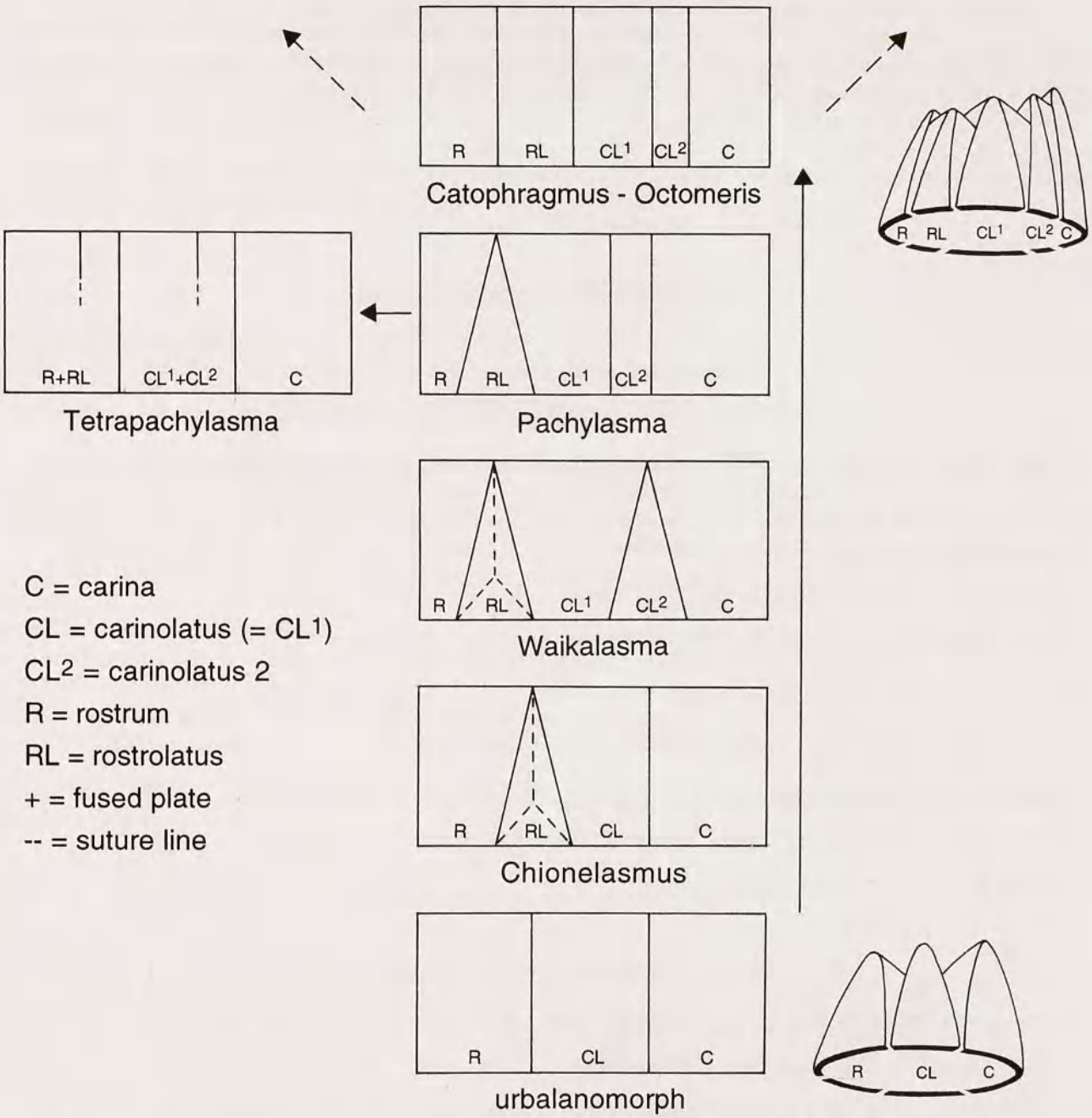

FIG. 1. — Schematic representation of wall organization in selected genera of lower Balanomorpha, viewed from right side (basal whorls of imbricating plates, where present, not shown). These reflect grades of wall construction rather than a strict phylogeny, but the polarity indicated by arrows reflects the general evolution of the balanomorph wall. Proceeding from the bottom, the urbalanomorph wall of four plates in which CL overlaps R and C (imbricating plates were present, radii absent). *Chionelasmus*, in which RL, derived from an imbricating plate, has been added to protect the R/L suture, upper portion of RL not incorporated into sheath and lower portion not fully incorporated into wall (imbricating plates present). *Waikalasma*, in which CL^2 has been added by replication of CL^1 rather than by transfert from the imbricating whorls; CL^2 but not RL enter the sheath. *Pachylasma*, in which RL and CL^2 are incorporated into wall but RL is not yet incorporated into sheath (imbricating plates absent in Recent forms). *Tetrapachylasma*, in which RL fuses with R to form compound rostrum (RL+R+RL), and CL^2 fuses with CL^1. *Catophragmus-Octomeris* (imbricating plates lost in latter), in which RL is incorporated into sheath. [From ROSS & NEWMAN, 1996, fig. 2 (part), reproduced with the permission of Dr Arthur HUMES, Editor, Journal of Crustacean Biology].

Source : MNHN, Paris

Ontogenetic studies have also shown the development of a second pair of latera, which are known to develop 3-4 days after metamorphosis in balanoids (DARWIN, 1854; COSTLOW, 1965). These are a replicate of the first pair (CL^1) and, therefore, are designated CL^2 (YAMAGUCHI & NEWMAN, 1990). It thus follows that the generalised 8-plated wall of balanomorphs is R-RL-CL^1-CL^2-C and in 6-plated forms with a compound rostrum the wall is R-CL^1-CL^2-C (ROSS & NEWMAN, 1996).

SYSTEMATIC ACCOUNT

Superorder THORACICA Darwin, 1854

Order SESSILIA Lamarck, 1818

Suborder BALANOMORPHA Pilsbry, 1916

Superfamily CHIONELASMATOIDEA Buckeridge, 1983

DIAGNOSIS. — Symmetrical sessile barnacles having primary shell wall composed of 6 distinct compartmental plates, including R, paired RL and CL, C (R-RL-CL-C) in contact with substratum, surrounded by single whorl, or several distinctly separate whorls, of basal imbricating plates; sheath formed by R, C and CL; basis thinly calcareous or membranous.

REMARKS. — See Remarks under Pachylasmatoidea.

DISTRIBUTION. — Upper Eocene to Recent (BUCKERIDGE, 1983).

Family CHIONELASMATIDAE Buckeridge, 1983

DIAGNOSIS. — As for the superfamily.

REMARKS. — The family comprises 2 genera, *Chionelasmus* and *Eochionelasmus*.

DISTRIBUTION. — Upper Eocene to Recent.

Genus ***EOCHIONELASMUS*** Yamaguchi, 1990

Eochionelasmus Yamaguchi, 1990 (in YAMAGUCHI & NEWMAN, 1990: 136).

TYPE SPECIES. — *Eochionelasmus ohtai* Yamaguchi, 1990.

DIAGNOSIS. — Primary wall surrounded by several distinct, basal whorls of monomorphic imbricating plates; caudal appendages present.

TYPES of *Eochionelasmus ohtai*. — *Holotype*: UMUT cat. no. RA-18631; Japan/French KAIYO 87 Cruise (Site B of station 4), North Fiji Basin, Southwest Pacific, 16°59.4'N, 173°54.9'E, 1990 m; 28.12.1987; holotype and paratypes attached to one another and to the ferro-manganese-coated, glassy crust of pillow basalt, temperature anomaly +0.1 to +0.2°C above an ambient of +2.2°C.

Paratypes: UMUT cat. no. RA-18632, UMUT RA-18633, UMUT RA-18634 (juvenile); USNM 221862; BMNH 1989.47; MNHN Ci 2110; all locations as for holotype.

Holotype depository: UMUT.

Paratypes depository: UMUT, USNM, BMNH, MNHN.

Source : MNHN, Paris

REMARKS. — Until recently only 1 species, *E. ohtai*, was attributed to this genus. In 1997 YAMAGUCHI and NEWMAN (1997a) described *E. paquensis* from the East Pacific Rise. In a subsequent paper, YAMAGUCHI and NEWMAN (1997b) proposed *E. ohtai manusensis* for the Manus Basin population, distinct from populations of *E. ohtai ohtai* in the North Fiji and Lau Basins, based on small but distinct differences in the ontogenetic development of the basal imbricating plates.

DISTRIBUTION. — Recent, from hydrothermal vents. South-west Pacific; North Fiji Basin; Lau Basin; Manus Basin, 1990-2500 m; East Pacific Rise, N of Easter Island, 2578 m.

Genus ***CHIONELASMUS*** Pilsbry, 1911

Catophragmus (*Chionelasmus*) Pilsbry, 1911: 82.
Chionelasmus - NILSSON-CANTELL, 1928: 445.

TYPE SPECIES. — *Chionelasmus darwini* (Pilsbry, 1907).

DIAGNOSIS. — Primary wall surrounded by basal, trimorphic, imbricating plates condensed into a single whorl; caudal appendages present.

REMARKS. — Until recently, only 1 species was attributed to this genus. However, during the final stages of preparation of the present manuscript, 2 papers were published that described a new subspecies and a new species, respectively. YAMAGUCHI (1998) proposed *Chionelasmus darwini cantelli* for the Indian Ocean population, distinct from the Hawaiian population of *Chionelasmus darwini darwini*, based on the morphology of the opercular plates and the ontogenetic development of the basal imbricating plates. In the same year, BUCKERIDGE (1998) described *Chionelasmus crosnieri*, a facultative coral-dwelling species from a guyot on the northern part of the Norfolk Ridge. In the light of these recent publications, re-examination of the material included below under *Chionelasmus darwini* may be warranted.

DISTRIBUTION. — Eocene, Tonga; Upper Eocene, New Zealand; Recent, western Indian Ocean to northern Pacific; 260-650 m.

Chionelasmus darwini (Pilsbry, 1907)

Figs 2-3, 4 a

Catophragmus darwini Pilsbry, 1907: 188, fig. 4, pl. 5 figs 1-8; 1916: 335.
Catophragmus (Chionelasmus) darwini - PILSBRY, 1911: 82.
Chionelasmus darwini - NILSSON-CANTELL, 1928: 445, figs 1-2; 1938: 14. — POPE, 1965: 10. — GORDON, 1970: 9, 105. — NEWMAN & ROSS, 1976: 40, frontispiece. — STANLEY & NEWMAN, 1980: 177. — FOSTER, 1981: 352, fig. 3. — BUCKERIDGE, 1983: 61, fig. 46. — HUI & MOYSE, 1984: 91, fig. 1. — NEWMAN, 1987: 23, figs 4, 5A, 6. — YAMAGUCHI & NEWMAN, 1990: 148, fig. 8.

MATERIAL EXAMINED. — **New Caledonia**. MUSORSTOM 4: stn CP 238, 500-510 m: 1 specimen.
SMIB 8: stn CP 180, 425-460 m: several specimens (WAM C 23243).
HALIPRO 2: stn BT 49, 605-628 m: several specimens attached to gorgonian.
Loyalty Islands. BIOCAL: stn DW 66, 505-515 m: 1 specimen. — Stn CP 67, 500-510 m: several specimens.
Norfolk Ridge. CHALCAL 2: stn CC 1, 500 m: 1 specimen. — Stn CC 2, 500 m: 1 specimen. — Stn CP 21, 500 m: 1 specimen. — Stn DW 74, 650 m: 1 specimen. — Stn DW 75, 600 m: 1 specimen. — Stn DW 76, 470 m: 4 specimens. — Stn DW 77, 435 m: 2 specimens.
SMIB 3: stn DW 24, 535 m: 1 specimen, attached to sponge.
SMIB 4: stn DW 55, 260 m: 1 specimen.
BATHUS 3: stn CP 812, 391-440 m: many specimens, attached to coral rubble (WAM 261-96). — Stn CP 815, 460-470 m: many specimens, attached to coral rubble (MNHN-Ci 2694). Drawn.

Source : MNHN, Paris

TYPES. — *Syntypes*: (from incomplete specimens) USNM 32407 [hard parts], USNM 32408 [soft parts]; *"Albatross"* station 3998, near Kauai, Hawaiian Is, 417-430 m.

Syntypes depository: USNM (material is missing).

DIAGNOSIS. — Wall consisting of 6 white, porcellanous plates, without radii. R with alae. S without adductor ridge; S and T with strongly developed articular ridges. Caudal appendages multi-articulate, 8-12 segments.

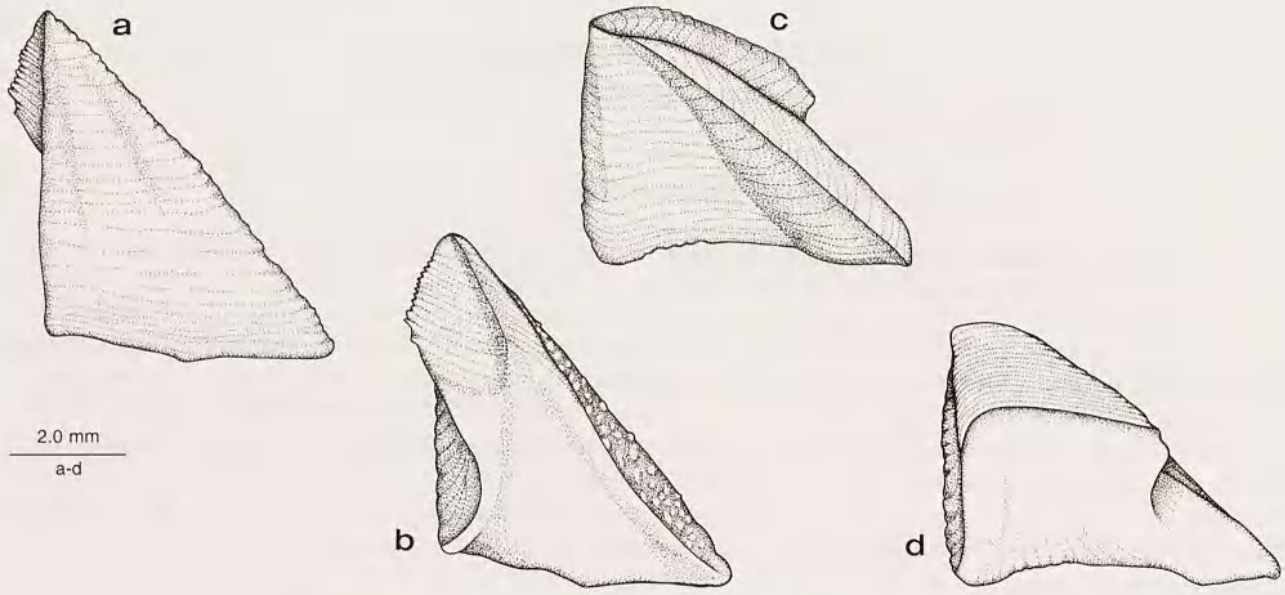

FIG. 2. — *Chionelasmus darwini* (Pilsbry, 1907). Specimen from BATHUS 3, stn CP 815 (MNHN-Ci 2694): **a**, S, external view; **b**, S, internal view; **c**, T, external view; **d**, T, internal view.

SUPPLEMENTARY DESCRIPTION. — Measurements of 10 specimens examined, randomly selected from several stations, as follows:

	RC length	LD	C height
rg	3.8-13.3	2.3-13.8	1.5-13.6
$\bar{x}$	9.3	7.5	6.3

Cirrus I shortest, rami unequal. Cirrus II resembling cirrus III more than cirrus I. Cirrus III unmodified, similar to cirri IV-VI. Chaetotaxy ctenopod. Cirral formula as follows:

		C I	C II	C III	C IV	C V	C VI	c. a.
MNHN-	left	10, 13	18, 19	20, 25	19+, 25	22, 26	25, 25	12
Ci 2694	right	9, 11	12, 13	9+, 20	18, 20	24, 26	25, 25	8

REMARKS. — This species was collected previously from the western Indian Ocean and from the southwestern and northern Pacific Ocean. The present specimens from the waters of New Caledonia expand the distribution of the species in the south-western Pacific Ocean and extend the depth range to between 260 and 650 m. The well preserved specimens in the present collection agree in general with previous descriptions of *C. darwini* from the Hawaiian Islands (PILSBRY, 1907) and Rodriguez Island (NILSSON-CANTELL, 1928). However, some variation exists in the form of the mandible. The material examined herein shows the pectinated inferior angle of

Source : MNHN, Paris

the mandible bifid on the right side, but roundly molariform on the left side. In addition, both mandibles lack the 2 small additional teeth between teeth 1 and 2 which were illustrated by NILSSON-CANTELL (1928). These differences may reflect intra-specific variation.

DISTRIBUTION. — Western Indian Ocean, south-western to northern Pacific Ocean: Rodriguez Island (9.5 mls N, 4.0 mls W of Port Mathurin), western Indian Ocean, 527 m; Kermadec Islands, south-west Pacific Ocean (30°34'S, 178°30'W), 501 m; Hawaiian Islands, north Pacific Ocean, 417-430 m. Now also known from New Caledonia, 425-510 m, the Loyalty Islands, 500-515 m and Norfolk Ridge, 260-650 m.

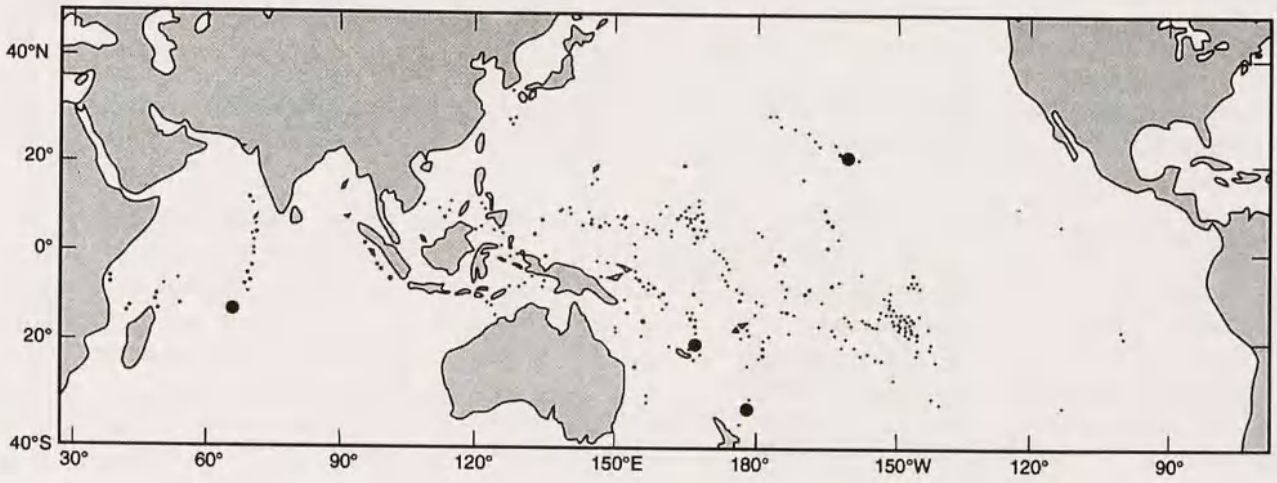

FIG. 3. — *Chionelasmus darwini* (Pilsbry, 1907). Distribution map (depth 260-650m).

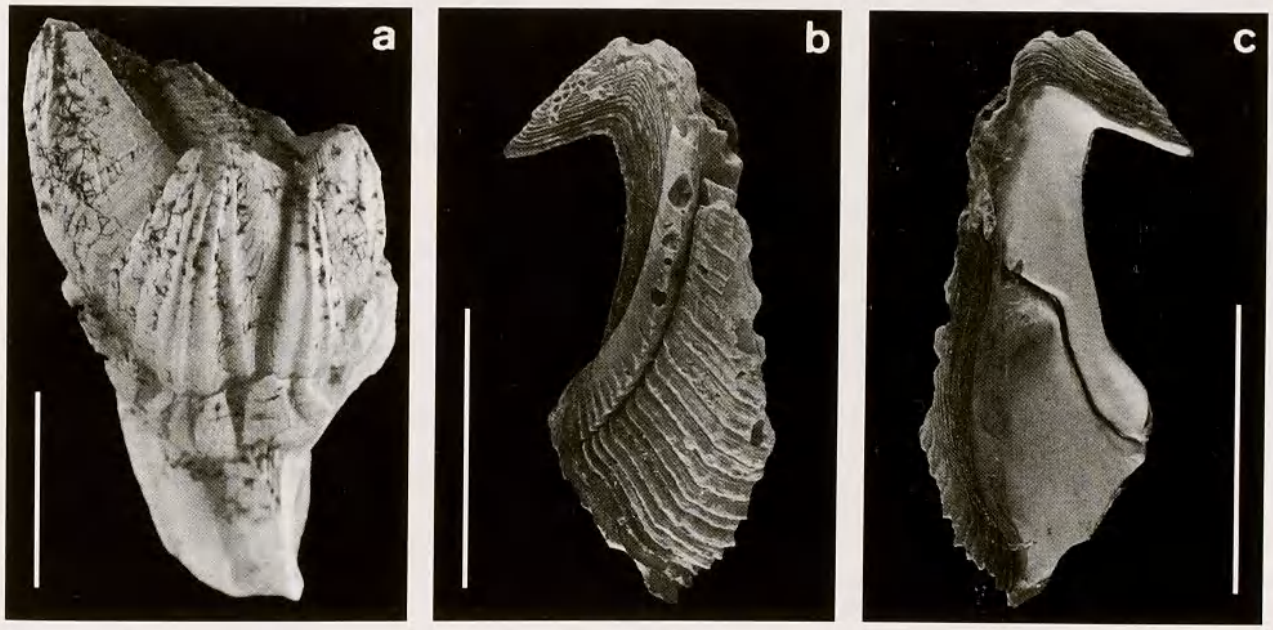

FIG. 4. — **a**, *Chionelasmus darwini* (Pilsbry, 1907). Specimen from BATHUS 3, stn CP 812 (WAM 261-96): lateral view.

FIG. 4. — **b-c**, *Waikalasma boucheti* Buckeridge, 1996. Specimen (incomplete) from BATHUS 3, stn DW 778 (MNHN-Ci 2410): opercular plates articulated together; **b**, external view; **c**, internal view. Scales = 0.5 cm for a; 1 cm for b-c.

Source : MNHN, Paris

Superfamily PACHYLASMATOIDEA Utinomi, 1968 (emend.)

DIAGNOSIS. — Wall composed of 8 distinct compartmental plates (R, paired RL, CL^1 and CL^2, and C), without (excepting *Waikalasma*) extra whorls of basal imbricating plates; rostrum compound, RL not entering sheath; parietes solid; radii, when present, solid; basis commonly membranous, or if calcareous solid, and not forming complex inter-digitations with wall.

DISTRIBUTION. — Paleocene to Recent; cosmopolitan (BUCKERIDGE, 1983).

REMARKS. — Prior to the work of NEWMAN and ROSS (1971) the extant deep-sea balanomorph genera *Pachylasma*, *Hexelasma*, *Chionelasmus* and *Bathybalanus*, and the fossil genus *Tessarelasma*, were included in the Chthamalidae (DARWIN, 1854; PILSBRY, 1916; UTINOMI, 1968). UTINOMI (1968) included 3 subfamilies within the family Chthamalidae, placing *Pachylasma*, *Hexelasma*, *Tessarelasma* and, curiously, *Bathybalanus* in the subfamily Pachylasmatinae and *Chionelasmus* in the Catophragminae. The third subfamily, the Chthamalinae, was composed of shallow-water species.

The revisionary work of NEWMAN and ROSS (1971) correctly removed *Bathybalanus* from the Chthamalidae and placed it in the Balanidae. These workers further proposed the family Bathylasmatidae to include the genera *Hexelasma* and the extinct *Tessarelasma* as well as 3 new deep-sea genera (*Bathylasma*, *Tetrachaelasma* and *Aaptolasma*), whilst retaining *Pachylasma* in the Chthamalidae. In a later revision NEWMAN and ROSS (1976) further separated *Pachylasma* and *Chionelasmus* from the Bathylasmatidae by placing the Bathylasmatidae in the superfamily Coronuloidea, and retaining *Pachylasma* and *Chionelasmus* in the Chthalamoidea (in the Chthamalidae and the Catophragmidae, respectively). The Bathylasmatidae was divided into the Bathylasmatinae, which contained *Bathylasma*, *Tessarelasma* and *Tetrachaelasma* and the Hexelasmatinae which contained *Hexelasma* and *Aaptolasma*.

FOSTER (1978) maintained that *Pachylasma* and *Hexelasma* were closely related, as had been noted previously by PILSBRY (1916). Furthermore, basing his conclusions upon shell construction, FOSTER (1978) proposed that *Chionelasmus* should be grouped with *Pachylasma*, *Hexelasma*, *Aaptolasma* and *Tetrachaelasma* in the family Pachylasmatidae, as distinct from the Chthamalidae which contained *Chthamalus*, *Catophragmus*, *Octomeris*, *Tetrachthalamus* and *Chamaesipho*. In a further revision, FOSTER (1981) synonymised *Aaptolasma* with *Hexelasma* and transferred *Bathylasma* and *Mesolasma* to the Pachylasmatidae.

The superfamilial rank Pachylasmatoidea was proposed by BUCKERIDGE (1983) for the families Pachylasmatidae and Tetraclitidae, but the latter was later assigned to the Tetraclitoidea (NEWMAN, 1993). Within the Pachylasmatidae 5 subfamilies were recognised, i.e. Chionelasmatinae, Pachylasmatinae, Eolasmatinae, Bathylasmatinae and Hexelasmatinae. BUCKERIDGE (1983) noted that both *Chionelasmus* and *Pachylasma* had weakly articulated plates without radii and, in this respect, showed more in common with *Hexelasma* and *Bathylasma* than the Chthamalidae. He also commented that the hexelasmatines and the living bathylasmatines (i.e. *Hexelasma*, *Bathylasma*, *Tetrachaelasma*) had a more specialised body morphology than *Chionelasmus* and *Pachylasma*, as they did not possess caudal appendages. BUCKERIDGE (1983) suggested that *Pachylasma* represented an intermediate stage between an 8-plated and extra whorled balanomorph and the 6-plated, single whorled Hexelasmatinae and, furthermore, that *Chionelasmus* was a plesiomorphic living balanomorph. His phylogenetic tree (BUCKERIDGE, 1983) showed *Pachydiadema* as the most primitive balanomorph and, on p. 21, he derived *Chionelasmus* "... perhaps [evolving] directly from *Pachydiadema*". BUCKERIDGE, however, based his ideas on the now-considered false notion of NEWMAN (pers. comm.) that *Chionelasmus* possibly changed from 8- to 6-plated during ontogeny (as suggested by NEWMAN 1987). *Chionelasmus* became the "most primitive living balanomorph" in the works of YAMAGUCHI and NEWMAN (1990) and BUCKERIDGE and NEWMAN (1992). In 1990, what is now considered the most primitive living member of the suborder Balanomorpha, *Eochionelasmus*, was described from the North Fiji Basin (YAMAGUCHI & NEWMAN, 1990). NEWMAN (1987) proposed the superfamilial rank Chionelasmatoidea to embrace the Chionelasmatidae and *Chionelasmus* and *Eochionelasmus*.

YAMAGUCHI and NEWMAN (1990) and NEWMAN and YAMAGUCHI (1995) proposed a new hypothesis concerning the evolution of the 8-plated balanomorph wall, based on evidence concerning the organisation of the

Source : MNHN, Paris

shell of *Eochionelasmus* and *Neobrachylepas*, the ontogeny of the shell wall of *Chionelasmus* and the ontogeny of *Balanus s.l.* This evidence suggested that the true (median) lateral plate is replaced by the CL plate in the balanomorphs, and that an additional, secondary CL plate (CL^2) is added by replication in advanced balanomorphs. In the light of these findings, BUCKERIDGE and NEWMAN (1992) reinterpreted the structure of the wall of the fossil eolasmatine *Waikalasma juneae*, proposing that *Waikalasma* was amongst the most plesiomorphic of balanomorph barnacles and not merely an evolutionary offshoot. Subsequently, BUCKERIDGE (1996) described an extant species of *Waikalasma*, the first living representative of the eolasmatines.

In the lower balanomorphs (i.e. the Chionelasmatoidea) imbricating plates are present, as either a basal whorl (*Chionelasmus*) or whorls (*Eochionelasmus*). The wall is 6-plated (R-RL-CL-C), with RL derived from an imbricating plate which is added to protect the R/CL suture. The upper portion of RL is not incorporated into the sheath and the lower portion is not fully incorporated into the wall.

In the higher balanomorphs (e.g., the Pachylasmatoidea), CL^2 is added to the wall structure. Within the Pachylasmatidae, two whorls of imbricating plates are present in the eolasmatine *Waikalasma*. The wall is 8-plated (R-RL-CL^1-CL^2-C), with CL^2 added by the replication of CL^1, rather than by transfer from the imbricating whorls. CL^2 only slightly enters the sheath as a very narrow sliver. In the pachylasmatine *Pachylasma*, imbricating plates are absent in Recent forms. Imbricating plates are also absent in the new pachylasmatine genera described in the present paper (*Eutomolasma* gen. nov., *Eurylasma* gen. nov. and *Microlasma* gen. nov.). In these pachylasmatines the wall is 6-plated (R-CL^1-CL^2-C), RL and CL^2 are incorporated into the wall but RL is not incorporated into the sheath. In *Eurylasma* CL^2 is partially coalesced with CL^1, but CL^2 enters the sheath as a very narrow zone. The pachylasmatine *Tetrapachylasma* has a wall that may be 6- or 4-plated, depending on the degree of coalescence of the plates. In the 6-plated form (R-CL^1-CL^2-C), RL coalesces with R to form a compound rostrum (RL+R+RL). In the 4-plated wall (R-CL-C), RL and R form a compound rostrum (RL+R+RL) and CL^2 is united with CL^1 to form a compound CL plate. CL^2 enters the sheath as a narrow zone but RL is not incorporated into the sheath (except in *T. ornatum* sp. nov.).

Imbricating plates are absent in the new subfamily Metalasmatinae described herein, and in the Bathylasmatinae and the Hexelasmatinae. In the Metalasmatinae, the Hexelasmatinae and the bathylasmatines *Bathylasma*, *Mesolasma* and *Tessarelasma*, the wall is 6-plated (R-CL^1-CL^2-C), RL and CL^2 are incorporated into the wall but RL is not incorporated into the sheath. The bathylasmatinae *Tetrachaelasma* has a 4-plated wall (R-CL-C), due to the absence of CL^2. Thus in the Pachylasmatoidea the RL does not enter the sheath (with the exception of the tetrapachylasmatid *T. ornatum*, which shows the incipient inclusion of RL into the sheath).

Family PACHYLASMATIDAE Utinomi, 1968 (emend.)

Tables 1-2

DIAGNOSIS. — Wall composed of 8 distinct, calcareous plates (R-RL-CL^1-CL^2-C); adults externally with 8, 6 or 4 plates differentiated; diametric growth of shell effected by alar growth of R (when distinct), CL^1 and CL^2, and C; radii absent; sutural edges not complexly interlocked.

REMARKS. — Within the Pachylasmatidae 5 subfamilies were recognised by BUCKERIDGE (1983), i.e. Chionelasmatinae, Pachylasmatinae, Eolasmatinae, Bathylasmatinae and Hexelasmatinae. NEWMAN (1987) later proposed the Chionelasmatoidea, containing the Chionelasmatidae. A new pachylasmatid subfamily, the Metalasmatinae, is defined and described herein. The chionelasmatoids possess caudal appendages and, in the pachylasmatoids, the metalasmatines and pachylasmatines, but these structures are absent in the eolasmatines, bathylasmatines and hexelasmatines.

Adult pachylasmatoids have a variety of shell plate patterns when viewed externally, i.e. 8, 6 or 4 plates. The 8-plated adult pattern is represented by R, paired RL, paired CL^1 and CL^2, and C (R-RL-CL1-CL^2-C). This pattern occurs in the eolasmatines. In the 6-plated adult pattern there is a compound rostral plate, paired CL^1 and CL^2, and C (R-CL^1-CL^2-C). The compound rostral plate may have the rostral suture between R and RL visible

Source : MNHN, Paris

TABLE 1. — Pachylasmatidae: characters of the subfamilies.

	no. plates ext.	no. plates int.	imbricating plates +	imbricating plates -	R and RL	CL¹ and CL²	alar growth ridges	alar welting
EOLASMATINAE	8	8	+	-	separate	separate	parallel to inferior alar margin	absent
PACHYLASMATINAE	6	8		-	compound	separate	parallel to inferior alar margin	absent
	6	6		-	compound	separate		
	4	6		-	compound	partially coalesced		
	4	4		-	compound	coalesced		
METALASMATINAE **subfam. nov.**	6	6		-	compound	separate	sinuously parallel to inferior alar margin	absent; superior alar margin of C thickened in distal 1/2; CL¹ and CL² thickened in distal 1/3
BATHYLASMATINAE	6	6		-	compound	separate	diverging from inferior alar margin	narrow
	4	4		-	compound			
HEXELASMATINAE	6	6		-	compound	separate	parallel or diverging from inferior alar margin	narrow to moderate

ext. = external; int. = internal; + = present; - = absent or not applicable.

TABLE 2 . — Pachylasmatidae: characters of the subfamilies (continued).

	parietal growth ridge	opercular plates	basis	chitin in parietal plates	c.a.	mandible
EOLASMATINAE	low; lacking small setae	T artic. ridge prom. S artic. ridge not proj.	membranous	absent	absent	tridentoid
PACHYLASMATINAE	low; lacking small setae	T artic. ridge varies from not proj. to proj. S artic. ridge varies from not proj. to proj.	membranous, or membranous/ calcareous, or calcareous	absent	present, sometimes reduced/ vestigial	tridentoid
METALASMATINAE subfam. nov.	prom., with small setae	T artic. ridge proj. S artic. ridge proj.	membranous	present	present	tridentoid
BATHYLASMATINAE	prom., with small setae	T artic. ridge varies from not proj. to proj. S artic. ridge proj.	membranous or calcareous	absent	absent	quadridentoid
HEXELASMATINAE	prom., with small setae	T artc. ridge not proj. S artic. ridge not proj.	calcareous, sometimes membranous centrally	present	absent	quadridentoid

artic. = articular; c.a. = caudal appendage; proj. = projecting; prom. = prominent.

(occasionally obscure) externally and internally; internally a total of 8 plates is differentiated since R and RL still retain their integrity. Rostral sutures are absent when the coalescence of R and the paired RL is complete; internally a total of 6 plates is differentiated. In the 6-plated adult pattern, CL¹ and CL² may be distinct entities, or partially coalesced, but in the latter condition CL² still retains a discrete, reduced ala and the suture line is visible internally and externally. The 6-plated pattern occurs in the subfamily Metalasmatinae described herein and in the hexelasmatines, some pachylasmatines (*Eutomolasma* gen. nov., *Microlasma* gen. nov., *Eurylasma* gen. nov.,

Source : MNHN, Paris

Pachylasma) and some bathylasmatines (*Bathylasma, Mesolasma*). In the 4-plated adult pattern CL^2 may never develop — this condition is seen in some bathylasmatines (*Tetrachaelasma, Tessarelasma*).

However, whilst the shell wall pattern is regarded as "fixed" at either 8, 6 or 4 plates for the majority of pachylasmatoid genera (e.g., 8 for *Waikalasma*, 6 for *Pachylasma*, 4 for *Tetrachaelasma*), one genus (*Tetrapachylasma*) exhibits a "variable" pattern, where adult populations contain individuals with 6 or 4 plates. In the 6-plated individuals there is a compound rostral plate, and CL^1 and CL^2 can be separate or show degrees of coalescence. In the 4-plated individuals CL^1 and CL^2 are coalesced, there is a compound rostral plate, and a C.

DISTRIBUTION. — Upper Eocene to Recent; cosmopolitan. All living species inhabit shallow to deep waters.

Key to the Subfamilies of the Family PACHYLASMATIDAE

Tables 1-2

1. Primary shell wall of adult externally 8-plated; R and RL plates separate; with or without extra whorls of basal imbricating plates ..... **EOLASMATINAE**
— Primary shell wall of adult externally 6- or 4-plated; R and RL forming a compound rostral plate; without extra whorls of basal imbricating plates **2**

2. Alar welting absent; caudal appendages present, sometimes reduced or vestigial; mandible tridentoid **3**
— Alar welting present; caudal appendages absent; mandible quadridentoid **4**

3. Chitinous rods or lamina absent in wall plates; horizontal growth ridges low, lacking small setae; superior alar margins of C, CL^2 and CL^1 not thickened distally ..... **PACHYLASMATINAE**
— Chitinous rods or lamina present in wall plates; horizontal growth ridges prominent, with small setae; superior alar margins of C, CL^2 and CL^1 thickened distally ..... **METALASMATINAE** subfam. nov.

4. Chitinous tubes or lamina absent in wall plates; articular ridge of S prominent ..... **BATHYLASMATINAE**
— Chitinous tubes or lamina present in wall plates; articular ridge of S not prominent ..... **HEXELASMATINAE**

Subfamily EOLASMATINAE Buckeridge, 1983

Tables 1-2

DIAGNOSIS. — Primary wall with 8 solid calcareous compartmental plates (R-RL-CL^1-CL^2-C); with or without whorls of imbricating plates; basis membranous.

TYPE GENUS. — *Eolasma* Buckeridge, 1983.

DISTRIBUTION. — Upper Paleocene to Lower Miocene: New Zealand, Australia. Recent: South-west Pacific (off Vanuatu and off the Loyalty Ridge), 700-850 m.

REMARKS. — Presently the Eolasmatinae contains 2 genera, *Eolasma* and *Waikalasma*. *Eolasma*, and hence the type genus of the eolasmatines, is based on a handful of disarticulated plates, which may or may not be from the same species. Thus, there is no guarantee that the genus is 8-plated. Intact specimens of *Eolasma*, as yet unknown, would indicate whether *Waikalasma*, which is 8-plated and which has additional whorls of basal imbricating plates, is related to *Eolasma* or whether *Waikalasma* belongs elsewhere, and not in this subfamily.

Source : MNHN, Paris

Genus *WAIKALASMA* Buckeridge, 1983

Waikalasma Buckeridge, 1983: 64.

DIAGNOSIS. — Wall with 8 solid, weakly articulated, calcareous compartmental plates including narrow R, paired RL, CL^1 and CL^2, and wide C; alae well developed, particularly on C, barely inset from paries; radii absent; 4 whorls of imbricating plates present; basis membranous; caudal appendages absent.

TYPE SPECIES. — *Waikalasma juneae* Buckeridge, 1983.

FOSSIL SPECIES. — *Waikalasma juneae* Buckeridge, 1983.

RECENT SPECIES. — *Waikalasma boucheti* Buckeridge, 1996.

TYPES OF *Waikalasma juneae*. — *Holotype*: AU 5622 R13/f7078; A 131, articulated shell with all eight compartments present but in varying stages of decortication, from the Waikawua Formation (Otaian), collected by J. and J. BUCKERIDGE.

Paratypes: from AU 5622, A 132 carina; from AU 6849, A 133 carina; from AU 5622, A 134 incomplete rostrum.

Holotype and paratype depository: AU.

DISTRIBUTION. — Lower Miocene to Recent. Oceania.

REMARKS. — Until recently the genus contained a single fossil species, *W. juneae*. However, the first known living representative of the Eolasmatinae, *W. boucheti* Buckeridge, has recently been described from the seas off Vanuatu, in the south-western Pacific Ocean (BUCKERIDGE, 1996). In the present report an incomplete specimen collected from the Loyalty Ridge is also attributed to *W. boucheti*.

Waikalasma boucheti Buckeridge, 1996

Figs 4 b-c, 5-7

Waikalasma boucheti Buckeridge, 1996: 449.

MATERIAL EXAMINED. — **Loyalty Ridge**. BATHUS 3: stn DW 778, 750-760 m: 1 specimen (incomplete) (MNHN-Ci 2410). Drawn.

TYPES. — *Holotype*: MNHN-Ci 2428; Vanuatu, MUSORSTOM 8, stn CP 1080, 15°57.4'N, 167°27'E, 799-850 m; 05.10.1994.

Paratype: MNHN-Ci 2506; Vanuatu, MUSORSTOM 8, stn DW 1113, 14°53'N, 167°06'E, 700-736 m; 08.10. 1994.

Holotype and paratype depository: MNHN.

DIAGNOSIS. — *Waikalasma* with 2 or more whorls of large imbricating plates, inner whorl with total of 8 plates; S triangular, very elongate, with long, low articular ridge, adductor muscle scar weak, central; T narrow, inverted 'V' shaped, basal margin deeply excavated, spur at basi-scutal angle.

SUPPLEMENTARY DESCRIPTION. — Incomplete specimen consisting of C, paired opercular plates and soft body; R, CL^1 and CL^2 not recovered. C solid, large; external growth ridges regular, low, giving plate smooth appearance, faint indications of 2 (?3) weak longitudinal ribs; C height 13.7; plate sloping inward gently toward orifice, apex slightly spout-like, retroverted; alae triangular, large, placed approximately at right angle to paries, basal outline rectangular, basal widths of alae and paries equal, alar growth ridges sinuously paralleling inferior alar margin, alar welting absent; internally sheath covering 2/3 height of valve, inner surface of C below sheath smooth; base of C slightly inflected inward, with lamina of chitin close to inner surface. Basis unknown. S triangular; elongate, height more than twice width, externally with many spaced, regular, growth ridges; articular ridge barely

Source : MNHN, Paris

projecting; internally adductor muscle scar slightly above middle of valve; depressor muscle scars indistinct. T narrow, height 6 times width; "boomerang" shape due to deep indention of basal margin; externally well spaced, regular, growth ridges; articular ridge projecting; internally tergal muscle crests lacking. Internal articular junction between opercular plates sinusoidal. Color of preserved material dirty cream, with some brown markings.

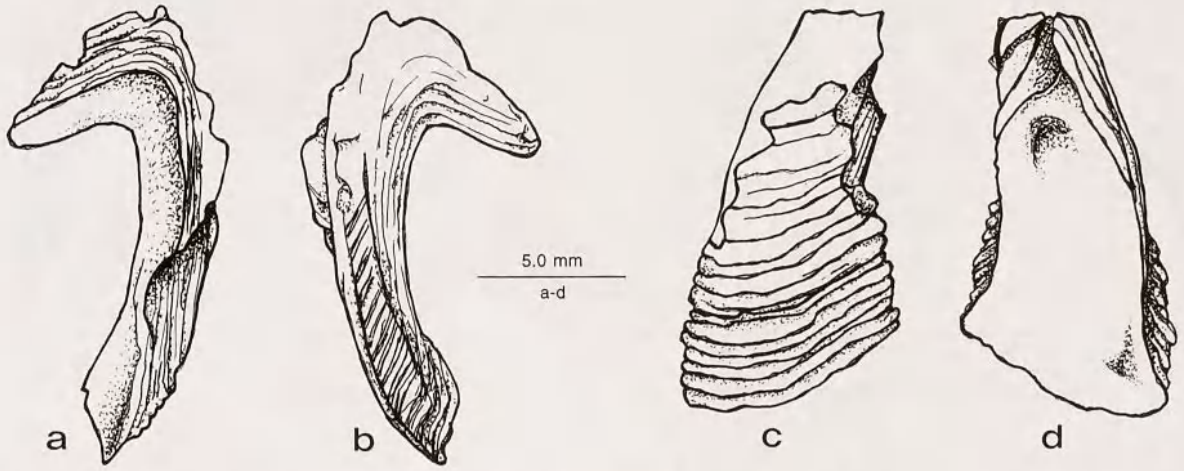

FIG. 5. — *Waikalasma boucheti* Buckeridge, 1996. Specimen (incomplete) from BATHUS 3, stn DW 778 (MNHN-Ci 2410): **a**, T, internal view; **b**, T, external view; **c**, S, external view; **d**, S, internal view.

Labrum with shallow medial depression, numerous small teeth (approximately 47) across margin. Mandibular palp ovate; dense setae terminally. Mandible with 3 teeth, tooth 1 largest, slightly separated from teeth 2 and 3; upper margins of 2 and 3 smooth; inferior angle 1/3 length of margin, bluntly molariform, sharply dentate. Maxillule with 1-2 pairs of long, stout setae at upper angle; slight notch indicated 1/3 length down cutting margin, dense spines on either side of notch, 7-9 pairs of smaller spines above notch, 7-9 pairs of larger setae below notch; inferior angle small, straight, not protuberant, with 5-6 pairs of small setae. Maxilla wide; lobes indistinct; long serrulate setae terminally.

Cirrus I with rami subequal; anterior ramus slightly longer and wider than posterior; both rami thickly setose, setae finely serrulate distally. Cirrus II similar to cirrus III, longer than cirrus I; rami subequal; both rami with proximal segments setose, setae simple or serrulate, both rami with distal segments tending toward antenniformy, segments becoming oblong. Cirrus III with rami subequal, segments becoming oblong distally; posterior ramus with 2-3 pairs of long, finely serrulate setae on anterior faces of distal segments; anterior ramus with 2-3 pairs of long, finely serrulate setae on anterior faces of distal segments, proximal segments with 4 pairs. Cirrus IV to VI similar, longer than cirrus III; segments oblong, with 2-4 pairs of setae on anterior faces, distal 2 pairs of setae longest, finely serrulate. Chaetotaxy ctenopod. Cirral formula as follows:

		C I	C II	C III	C IV	C V	C VI	c. a.
MNHN-	left	11, 12	21, 18+	23, 23	28, 27	15+, 24+	31, 18+	absent
Ci 2410	right	11, 13	20, 5+	22, 27	31, 32	33, 32	31, 32	absent

Caudal appendages absent. Penis less than height of basal segment of pedicel of cirrus VI; annulated; naked; without tufts of long setae distally.

REMARKS. — Externally there are faint indications of 2, possibly 3, weakly developed longitudinal ribs on the C. Although no basal whorls of imbricating plates were found associated with the incomplete specimen, the "chitinous lamina" in the slightly inwardly inflected base of C may be all that remains of the infolded, basal portion of the imbricating plates, as described in *W. boucheti* (BUCKERIDGE, pers. comm.), and thus the presence of imbricating plates may be inferred.

Source : MNHN, Paris

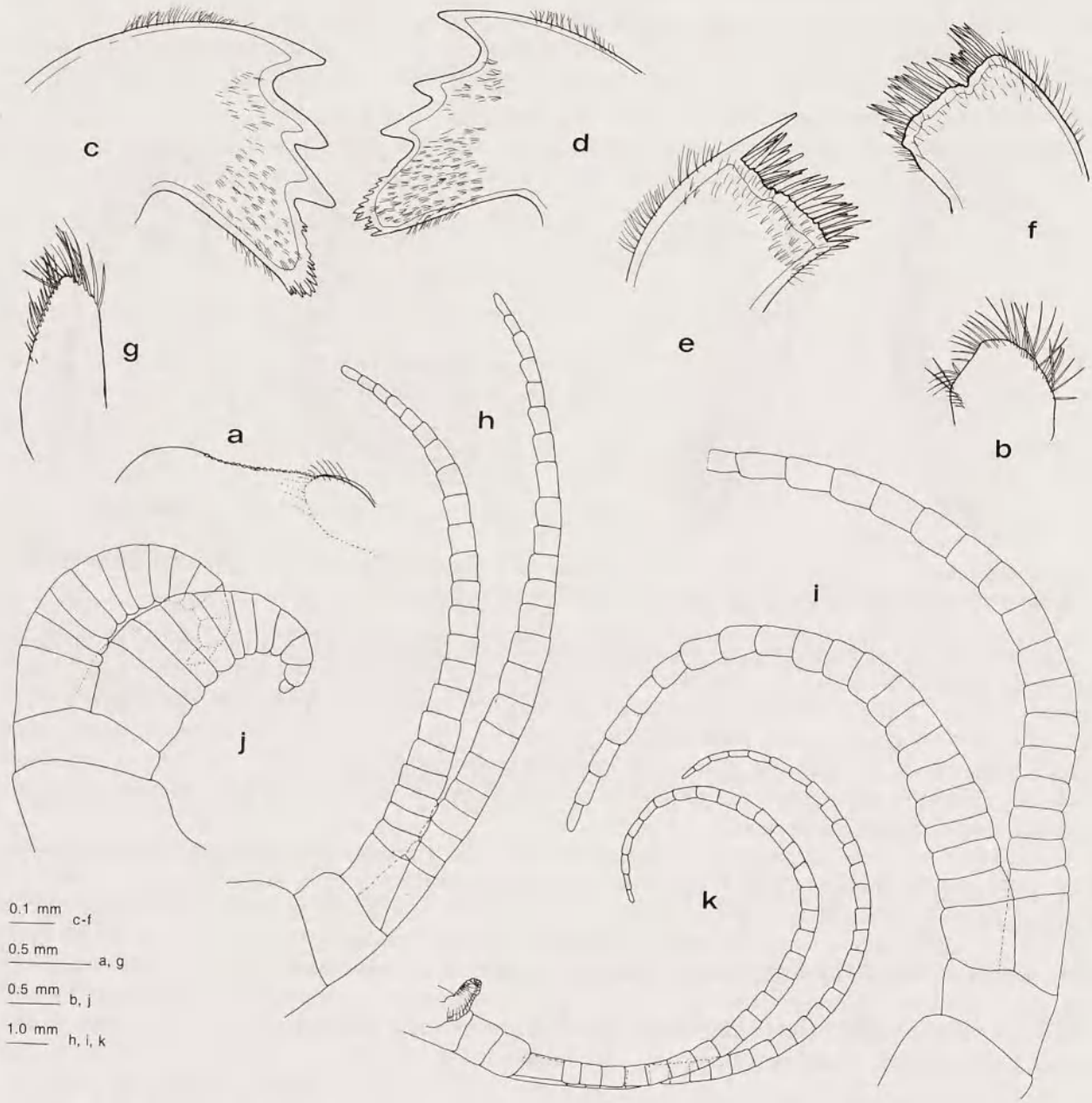

FIG. 6. — *Waikalasma boucheti* Buckeridge, 1996. Specimen (incomplete) from BATHUS 3, stn DW 778 (MNHN-Ci 2410): **a**, labrum; **b**, maxilla; **c**, right mandible; **d**, left mandible; **e**, right maxillule; **f**, left maxillule; **g**, mandibular palp; **h**, cirrus III; **i**, cirrus II; **j**, cirrus I; **k**, cirrus VI.

There are some variations in the soft part morphology of the present material compared to the specimen described from off Vanuatu by BUCKERIDGE (1996). The inferior angle of the mandible is large (1/3 the length of the cutting margin), bluntly molariform and sharply dentate; the maxillule has a slight notch 1/3 the distance down the cutting margin, with dense spines on either side; the labrum has an extremely shallow medial depression with numerous conical small teeth along the crest; cirrus I is much shorter than cirrus II and the proximal segments of both rami of cirrus I are much broader and narrower than the corresponding segments in cirrus II. The totality of these differences would suggest that we are dealing with 2 distinct species. However, the paucity of complete specimens precludes further discussion.

Source : MNHN, Paris

DISTRIBUTION. — Vanuatu (700-850 m); Loyalty Ridge (750-760 m).

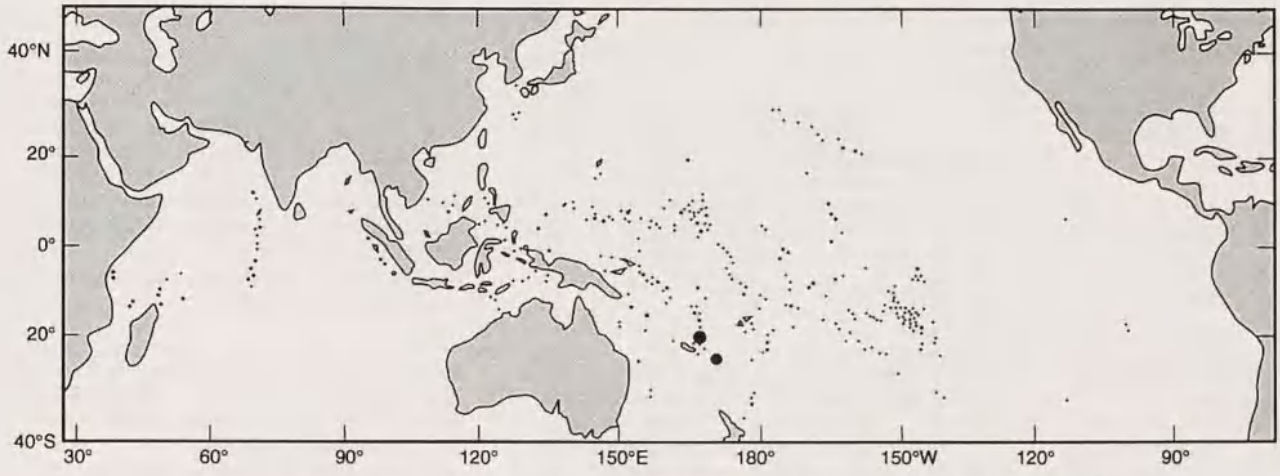

FIG. 7. — *Waikalasma boucheti* Buckeridge, 1996. Distribution map (depth 700-850 m).

Genus ***EOLASMA*** Buckeridge, 1983

Eolasma Buckeridge, 1983: 62.

DIAGNOSIS. — Shell with 8 solid calcareous compartmental plates (R-RL-CL^1-CL^2-C); external alar growth ridges parallel inferior alar margin; T with prominent articular ridge, S with articular ridge weakly elevated; basis membranous.

TYPE SPECIES. — *Eolasma maxwelli* Buckeridge, 1983.

FOSSIL SPECIES. — *Eolasma maxwelli* Buckeridge, 1983; *Eolasma rugosa* Buckeridge, 1985.

TYPES OF *Eolasma maxwelli*. — *Holotype*: GS11463 L35/F7537, AR 852 scutum [= number 5 on slide]; Eyre River Sands (Waipawan to Mangaorapan), White's Creek, collected by P. A. MAXWELL.

Paratypes: AR 853-864 twelve scuta; AR 865-871 seven terga; AR 872-874 three rostrolatera; AR 875-876 two carinae or rostra; AR 877-878 two carinolatera; AR 879-880 two latera; all same locality as holotype.

Holotype and paratype depository: New Zealand Geological Survey, Lower Hutt, New Zealand.

DISTRIBUTION. — Late Paleocene to early Eocene: New Zealand; Early Miocene: Victoria, Australia.

REMARKS. — BUCKERIDGE (1983) considered that the distinct alae and the lack of extra whorls of imbricating plates surrounding the primary shell wall make *Eolasma* more derived than *Waikalasma*.

Subfamily PACHYLASMATINAE Utinomi, 1968 (emend.)

Tables 1-4

DIAGNOSIS. — Wall not surrounded by whorl(s) of imbricating plates. Adult externally with 6 or 4 solid compartmental plates. Parietes with chitin absent; horizontal growth ridges low, lacking small setae. External alar growth ridges parallel to inferior alar margin, alar welting absent. Opercular plates with articular ridges varying from projecting to not projecting. Basis membranous or calcareous. Mandible tridentoid. Caudal appendages present, sometimes reduced or vestigial.

DISTRIBUTION. — Paleocene to Recent; Western Pacific, Africa, Mediterranean.

Source : MNHN, Paris

TABLE 3. — Pachylasmatidae: characters of the genera.

	no. plates ext.	no. plates int.	R: RL	CL^1:CL^2	CL^1 and CL^2	T artic. ridge and spur	S
EUTOMOLASMA gen. nov.	6	8	basal width R = basal width RL, or basal width R = 2 x basal width RL	basal width CL^2 = 1/5-1/2 basal width CL^1; height CL^2 = 4/5 height CL^1 to higher than CL^1 by 1/3	sep.	artic. ridge not proj. to proj.; spur varies from indistinct to 1/4 width of basal margin, set 1/5-1/9 width of basal margin from b-s angle	convex ext.; elongated, narrow; occludent margin 2 x width of basal margin; growth lines smooth, not cut by long. striae. S artic. ridge not proj.
MICROLASMA gen. nov.	6	8	basal width R = basal width RL	basal width CL^2 = 1/4-2/3 CL^1; height CL^2 = height CL^1or CL^2 shorter than CL^1 by 1/5	sep.	artic. ridge proj.; spur short to 1/2 height of valve, 2/9-1/2 width of basal margin, set from 1/8-1/10 width of basal margin from b-s angle	not convex ext.; as wide as high; growth lines smooth, not cut by long. striae. S artic. ridge proj.
PACHYLASMA	6	8	basal width R = basal width RL	basal width CL^2 = basal width CL^1; or basal width CL^2 = 1/2 basal width CL^1; height CL^2 = height CL^1	sep.	artic. ridge barely proj. to proj.; spur absent, indistinct, or short; 2/5-1/3 width of basal margin; set from 1/5-1/10 length of basal margin to at b-s angle	length of S basal margin 1/2 or >1/2 length of occludent margin; growth lines smooth, or convoluted, often cut by numerous long. striae. S artic. ridge varing from not proj. to proj.
	6	6	n.a.				
EURYLASMA gen. nov.	6	8	basal width RL = 3 x basal width R, or basal width RL = 6 x basal width R	basal width CL^2 = 1/2-9/10 basal width CL^1; height CL^2 = 3/4-9/10 height CL^1	part. fus.	artic. ridge not proj.; spur indistinct, 1/2-2/3 width of basal margin, not separated from b-s margin	subpyramidal or pyramidal form; concave ext.; length of basal margin 2/5-5/12 length of occludent margin; growth lines convoluted, may be cut by long. striae. S artic. ridge not or barely proj.
	6	6	n.a.				
TETRAPACHYLASMA	6	8	basal width R = basal width RL	basal width CL^2 = 1/2 to equal basal width CL^1; height CL^2 = height CL^1	part. fus. or fus.	artic. ridge proj.; spur indistinct or short, 1/3-1/2 width of basal margin; set at or at distance of 1/7-1/12 length basal margin from b-s angle	length of basal margin 1/2-7/10 length of occludent margin; growth lines sinuous or convoluted, often cut by l4-8 long. striae. S artic. ridge proj. or not proj.
	6	6	n.a.				
	4	6	n.a.				
	4	4	n.a.				

artic. = articular; b-s = basi-scutal; ext. = external; fus. = fused; int. = internal; long. = longitudinal; n.a. = not applicable; part. fus. = partly fused; proj. = projecting; sep. = separate.

REMARKS. — BUCKERIDGE (1983) considered that this subfamily was represented by a single genus, *Pachylasma*, containing 12 species, of which 3 were fossil. Prior to the present study 3 more extant species of *Pachylasma* were described (FOSTER, 1981; ROSELL, 1981; JONES, 1993b). A second pachylasmatine genus, *Tetrapachylasma*, was described by FOSTER (1988). Herein I describe 3 new genera within the Pachylasmatinae (*Eutomolasma* gen. nov., *Eurylasma* gen. nov. and *Microlasma* gen. nov.) together with 11 new species. The diagnosis of *Tetrapachylasma* Foster, 1988 is emended to reflect the infra-specific variation now recognised within this genus.

Source : MNHN, Paris

TABLE 4. — Pachylasmatidae: characters of the genera (continued).

	caudal appendage	mandible	basis	size (max.)	distribution/depth
EUTOMOLASMA gen. nov.	11-17 segments; from longer than pedicel of CVI by 1/4 height of pedicel of CVI to > twice height of pedicel of CVI	tridentate; upper margins of teeth 2 and 3 with weak subsidiary cusps	calcareous, or calcareous/ membranous, or membranous	RC length 10.5 C height 8.2 to RC length 23.0 C height13.6	W to central Pacific; 55-647 m
MICROLASMA gen. nov.	6-9 segments; from < than 1/2 height of basal segment of pedicel of CVI to slightly longer than height of pedicel of CVI	tridentate; margins of teeth smooth or upper margins of teeth 3 and/or 2 often with subsidiary cusps	membranous	RC length 5.3 C height 3.0 to RC length 9.0 C height 7.0	W Pacific; 120-423 m
PACHYLASMA	varying from absent, or uniarticulate, to 19 segments; height from minute to 1/3 > length of pedicel of CVI	tridentate; upper margins of teeth 2 and/or 3 smooth or with subsidiary cusps	calcareous, or calcareous/ membranous, or membranous	RC length 7.0 C height 2.5 to RC length 30.0 C height 30.5	Mediterranean; Indian Ocean to central Pacific Ocean; 104-616 m
EURYLASMA gen. nov.	5-13 segments; from 1/2 height of distal segment of pedicel of CVI to longer than height of pedicel of CVI by 1/4	tridentate; upper margins of teeth 2 and 3 often with subsidiary cusps	calcareous	RC length 9.7 C height 7.5 to RC length 15.0 C height 10.6	Loyalty Is, Vanuatu, Norfolk Ridge; 255-470 m
TETRAPACHY-LASMA	short (length of basal segment of pedicel of CVI) to long (twice length of pedicel of CVI)	tridentate; upper margins of teeth 2 and 3 with subsidiary cusps; sometimes subsidiary cusps in angle between teeth 1 and 2	calcareous or calcareous/ membranous	RC length 6.0 C height 2.5 to RC length 24.0 C height 7.0	W Pacific, W Australia; 3-610 m

The material examined herein indicates that some species have a fixed pattern of 6 wall plates in the adult, whilst others exhibit a variable pattern of either 6 or 4. The species which have a fixed pattern fall into 4 species groups. Given the other consistent morphological similarities exhibited by these groups of taxa, 3 can be considered justifiably as genera — i.e. *Eutomolasma* gen. nov., *Eurylasma* gen. nov. and *Microlasma* gen. nov. However the fourth group, *Pachylasma*, must be considered to be a grouping whose resolution has yet to be determined. The affinities of the various species included in this genus are still unclear and, until further specimens are collected and information on ontogenetic development and intra-specific variation assembled, it will be difficult to resolve the relationships of the various taxa.

Adults of *Eurylasma* gen. nov., *Eutomolasma* gen. nov., *Microlasma* gen. nov. and *Pachylasma* have a fixed pattern of 6-plates (compound rostral plate, paired CL^1 and CL^2, and C). In *Eutomolasma*, *Microlasma* and *Pachylasma,* CL^1 and CL^2 are separate entities. These plates are coalesced to a certain degree in *Eurylasma*, but the ala of CL^2 is still evident, albeit reduced - thus the adult is still regarded as 6-plated.

One genus, *Tetrapachylasma*, is herein regarded as having a variable wall pattern. Within this genus CL^1 and CL^2 may be separate entities, or coalesced to a certain degree, but the reduced ala of CL^2 is still evident. Both of these conditions represent a 6-plated shell (compound rostral plate, paired CL^1 and CL^2, and C). However, CL^1 and CL^2 can be totally coalesced, in which case the shell is regarded as 4-plated — i.e. compound rostral plate, paired CL plates (coalesced CL^1 and CL^2) and C. Both the 4- and the 6-plated condition occur within populations of the same species. No instances have been recorded of a 5-plated condition (i.e. CL^1 and CL^2 totally coalesced on one side only). Thus, the adult shell pattern of this genus is considered to be a variable pattern of either 4 or 6 parietal plates. Ontogenetic evidence has revealed that *Tetrapachylasma arcuatum* sp. nov. and 2 species which were included previously within *Pachylasma* (i.e. *P. aurantiacum* Darwin, 1854 and *P. ferrugomaculosa* Jones, 1993b)

Source : MNHN, Paris

may have either 4 or 6 plates in the adult. Similarities in the form of the wall plates, the opercular plates and body morphology suggest these species, along with *T. ornatum* sp. nov., can be included with *T. trigonum* Foster, 1988 to form a generic grouping.

Key to the genera of PACHYLASMATINAE

Tables 3-4

1. Adults with CL^1 and CL^2 partially coalesced (CL^2 retaining small ala) or coalesced (ala of CL^2 absent); rostral plate compound, sutures obscure or visible, basal width of R equal to or smaller (1/3 or 1/6 basal width) than basal width of RL **2**
— Adults with CL^1 and CL^2 separate; rostral plate compound, sutures obscure or visible, basal width of R equal to or wider (twice basal width) than basal width of RL **3**

2. Rostral plate compound, sutures obscure or visible, basal width of R smaller (1/3 or 1/6 basal width) than basal width of RL; S concave, sub-pyramidal or pyramidal, due to angled basal margin; articular ridge of T not projecting ..... ***EURYLASMA*** gen. nov.
— Rostral plate compound, sutures obscure or visible, basal width of R equal to basal width of RL; S not concave, not sub-pyramidal or pyramidal, basal margin straight; articular ridge of T projecting ..... ***TETRAPACHYLASMA***

3. Rostral plate compound, sutures visible, basal width of R equal to or wider (twice basal width) than basal width of RL; growth ridges of S even, smooth, not cut by longitudinal striae; basal width of CL^2 smaller (1/5-2/3 basal width) than basal width of CL^1 ..... **4**
— Rostral plate compound, sutures obscure or visible, basal width of R equal to basal width of RL; growth ridges of S convoluted, cut by longitudinal striae; basal width of CL^2 equal to basal width of CL^1 ..... ***PACHYLASMA***

4. Basal width of R equal to or wider (twice basal width) than basal width of RL; S convex externally, elongated and narrow; S articular ridge not projecting; caudal appendages long (from 1/4 longer than pedicel of cirrus VI to more than twice height of pedicel of cirrus VI), 11-17 segments; basal width of CL^2 1/5-1/2 basal width of CL^1 ..... ***EUTOMOLASMA*** gen. nov.
— Basal width of R equal to basal width of RL; S not convex externally, S as wide as high; S articular ridge projecting; caudal appendages short (from less than 1/2 height of basal segment of pedicel of cirrus VI to slightly longer than height of pedicel of cirrus VI), 6-9 segments; basal width of CL^2 1/4-2/3 basal width of CL^1 ..... ***MICROLASMA*** gen. nov.

Genus *EUTOMOLASMA* gen. nov.

Fig. 8; Tables 3-6

DIAGNOSIS. — Symmetrical shell form, orifice large. Adult with fixed shell-plate pattern of 6 parietal plates (R-CL^1-CL^2-C). Rostral plate compound, sutures visible, basal width of R equal to or twice basal width of RL. CL^1 and CL^2 separate. S convex externally; elongated, narrow; with smooth, even, transverse growth ridges, not cut by longitudinal striae. Caudal appendages longer than pedicel of cirrus VI by 1/4 to at least twice height of pedicel of cirrus VI; 11-17 segments.

TYPE SPECIES. — *Eutomolasma chinense* (Pilsbry, 1912).

RECENT SPECIES. — *Eutomolasma chinense* (Pilsbry, 1912); *E. japonicum* (Hiro, 1933); *E. maclaughlinae* sp. nov.; *E. orbiculatum* sp. nov.

Source : MNHN, Paris

TABLES 5 and 6. — *Eutomolasma* gen. nov.: characters of the species

	no. plates ext.	int.	R:RL	CL^1:CL^2	T	basis
E. chinense (Pilsbry, 1912)	6	8	R = RL	separate; CL^2 = 1/2 basal width CL^1	articular ridge not proj.; spur extremely short, wide; ext. with no long. ridge	calcareous thin centrally
E. japonicum (Hiro, 1933)	6	8	R = RL	separate; CL^2 = < 1/2 basal width CL^1; height CL^2 = 8/9 height CL^1	articular ridge slightly proj.; spur indistinct, set at 1/8 width of basal margin from b-s angle; ext. with long. ridge close to S margin; 6-7 muscle crests proj. below basal margin	membranous or partly calcareous
E. maclaughlinae sp. nov.	6	8	R = 2 x RL	separate; CL^2 = 1/2 basal width CL^1; height CL^2 = heigher than CL^1 by 1/3	articular ridge scarcely proj.; spur short, basally rounded, 1/8 width basal margin; set at distance of 1/10 width basal margin from b-s angle; ext. with 2 long., parallel ridges, 1 on each side of spur; 7-9 muscle crests, extending well beyond basal margin	membranous
E. orbiculatum sp. nov.	6	8	R = RL	separate; CL^2 = 1/4-1/5 basal width CL^1; height CL^2 = 4/5 height CL^1	articular ridge strongly proj.; spur indistinct, 1/4 width basal margin; set 1/5 width basal margin from b-s angle; ext. with long. ridge close to S margin; 15-18 small muscle crests, extending just beyond basal margin	membranous

b-s = basi-scutal; ext. = external; int. = internal; long. = longitudinal; proj. = projecting.

	S shape	S growth lines	caudal appendage	mandible	size (max.)	distribution	depth
E. chinense (Pilsbry, 1912)	convex ext.; S occludent margin 2.5 x length of basal margin; artic. ridge low	smooth, even, transverse, not cut by long. striae	unknown	unknown	RC length 16.5 C height 13.6	S China Sea	380 m
E. japonicum (Hiro, 1933)	feebly convex ext.; S occludent margin > 2 x S basal margin; S artic ridge not projecting	smooth, even, transverse, not cut by long. striae	13-14 segs; 2 x length of pedicel of CVI	tridentate; upper margins of teeth 2 & 3 with subsidiary cusps	RC length 21.0 R height 11.0	SW Japan	55-364 m
E. maclaughlinae sp. nov.	feebly convex ext.; S basal margin 7/15 S occludent margin; S artic. ridge not projecting	smooth, even, transverse, not cut by long. striae	11-17 segs, at least 2 x length of pedicel of CVI	tridentate; upper margins of teeth 2 & 3 with subsidiary cusps	RC length 10.5 C height 8.2	Lord Howe Ridge New Caledonia Loyalty Islands Norfolk Ridge Futuna Island Combe Bank Waterwich Bank	500-510 m 280-647 m 430-575 m 420-560 m 245-400 m 455 m 325-400 m
E. orbiculatum sp. nov.	convex ext.; S basal margin 1/2 S occludent margin; S artic. ridge . not projecting	smooth, even, transverse, not cut by long. striae	14-15 segs; longer than pedicel of CVI by 1/4 length of pedicel of CVI	tridentate; upper margins of teeth 2 & 3 with weak subsidiary cusps	RC length 23.0 CH 9.6	Loyalty Islands Norfolk Ridge	460 m 260-440 m

artic. = articular; b-s = basi-scutal; ext. = external; long. = longitudinal; max. = maximum; segs = segments.

Source : MNHN, Paris

REMARKS. — The symmetrical shell form and the large orifice, the externally convex, elongated and narrow S with smooth S growth ridges and the long caudal appendages (11-17 segments) distinguish this genus. Other distinguishing characters are listed in Tables 3-6. The species included herein are moderate (maximum: RC length 10.5, C height 8.2) to large (maximum: RC length 23.0, LD 29.9, C height 9.6, R height 9.0) in size and occur in association with gastropods, echinoderms, brachiopods, balanomorph and scalpellid barnacles, coral and pumice.

ETYMOLOGY. — From the Greek *eutomos*, "regular", in reference to the symmetrical form of the shells of the species in this genus.

DISTRIBUTION. — Western to central Pacific, 55-647 m: Loyalty Islands, Norfolk Ridge, 260-460 m (*E. orbiculatum*); Lord Howe Ridge, New Caledonia, Loyalty Islands, Norfolk Ridge, Futuna Island, Combe Bank, Waterwich Bank, 245-647 m (*E. maclaughlinae*); South China Sea, 380 m (*E. chinense*); SW Japan, 55-364 m (*E. japonicum*).

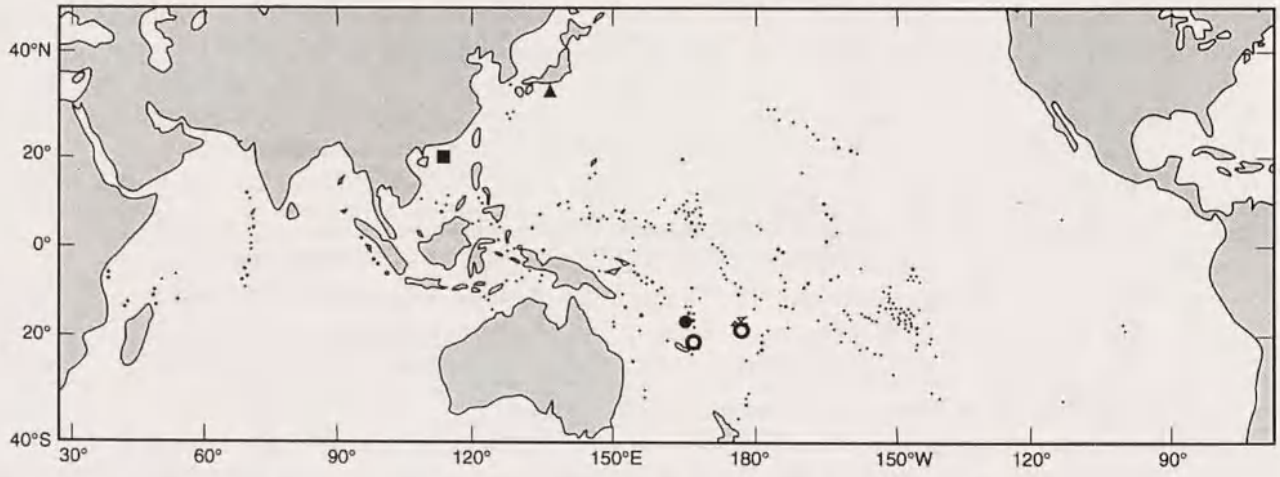

FIG. 8. — *EUTOMOLASMA* gen. nov. Distribution map: ■, *E. chinense* (380 m); ▲, *E. japonicum* (55-364 m); ●, *E. orbiculatum* (260-460 m); ○, *E. maclaughlinae* (245-647 m).

Eutomolasma chinense (Pilsbry, 1912)

Fig. 8; Tables 5-6

Pachylasma chinense Pilsbry, 1912: 293; 1916: 329. — NEWMAN & ROSS, 1976: 40.

TYPES. — *Holotype*: USNM Cat. No. 43471; *"Albatross"*, stn 5301, China Sea, near Hong Kong, 20°37'N, 115°43'E, 380 m, on scutum of a living *Scalpellum stearnsii* Pilsbry; mouthparts and caudal appendages on slide, shell and opercular plates separate.

Holotype depository: USNM (shell and opercular plates have not been located).

DIAGNOSIS. — Orifice piriform, toothed. Parietal plates thin, covered with thin, yellowish epicuticle. Basal width of R equal to basal width of RL, R separated from RL by sutures, inconspicuous externally, conspicuous internally. Basal width of CL^2 1/2 basal width of CL^1. Superior alar margins arched, finely serrate. S convex externally. T externally with longitudinal depression absent; articular ridge of T not projecting beyond articular margin; T spur short, wide.

REMARKS. — *Eutomolasma chinense* is a moderate sized species (maximum: RC length 16.5, C height 13.6), characterised by the equal basal widths of R and RL, the basal width of CL^2 being 1/2 the basal width of CL^1, and the S being externally convex.

Source : MNHN, Paris

The calcareous rather than membranous basis, the inconspicuous rather than conspicuous external sutures of the rostral plate, the basal width of CL^2 being 1/2 the basal width of CL^1, rather than less than 1/2 the basal width of CL^1; the alae being arched rather than parallel to the basis, the short and wide, rather than indistinct, tergal spur; the absence rather than presence of a longitudinal ridge externally on the T, close to the S margin; and the thin parietal plates, white with pink apices and covered with a yellowish epicuticle, rather than glossy pink plates, distinguish *E. chinense* from *E. japonicum*. The differences between *E. maclaughlinae* sp. nov. and *E. chinense* are listed under *E. maclaughlinae,* and between *E. orbiculatum* sp. nov. and *E. chinense* are listed under *E. orbiculatum.*

DISTRIBUTION. — South China Sea, 380 m.

Eutomolasma japonicum (Hiro, 1933)

Fig. 8; Tables 5-6

Pachylasma japonicum Hiro, 1933: 65; 1937: 430. — NEWMAN & ROSS, 1976: 40. — ROSELL, 1991: 37.

TYPES. — *Syntypes*: SMBL Type; station 303, off Toi-saki, Hiuga-nada, 31°16'00"N, 131°33'15"E, 364 m, 12.06.1928, bottom sand; 7 specimens attached to broken shells of *Clypeaster japonicus* Döderlein, together with *Scalpellum laccadivicum* Annandale.

Syntypes depository: SMBL (specimens have not been located).

DIAGNOSIS. — Form rounded oval from above. Parietal plates with numerous, smooth, regular growth ridges. Basal width of R equal to basal width of RL; rostral sutures visible externally. Basal width of CL^2 less than 1/2 basal width of CL^1. Alae broad, triangular, distinctly striped verically, summits almost parallel to basal margins. S elongate, triangular, externally feebly convex; articular ridge not projecting. T triangular, externally longitudinal ridge set close to S margin; articular ridge slightly projecting; 6-7 muscle crests projecting beyond basal margin; T spur indistinct.

REMARKS. — The slightly projecting tergal articular ridge, the 6-7 tergal muscle crests projecting beyond the tergal basal margin and the externally feebly convex S characterise *E. japonicum*. Differences between *E. japonicum* and *E. chinense* are listed under *E. chinense,* between *E. japonicum* and *E. maclaughlinae* sp. nov. under *E. maclaughlinae,* and between *E. japonicum* and *E. orbiculatum* sp. nov. under *E. orbiculatum. Eutomolasma japonicum* is a large species (maximum: RC length 21.0, R height 11.0).

DISTRIBUTION. — SW Japan, 55-364 m.

Eutomolasma maclaughlinae sp. nov.

Figs 8-11; Tables 5-6

MATERIAL EXAMINED. — **Chesterfield Islands**. MUSORSTOM 5: stn DC 388, 500-510 m: 2 specimens, attached to coral.

New Caledonia. *"Vauban"*: 12.04.1978: 8 specimens, some attached to shell of gastropod.

MUSORSTOM 4: stn CP 170, 460 m: 1 specimen. — Stn CP 179, 475 m: 1 specimen. — Stn CP 179, 475 m: 5 specimens, on pumice and shells of gastropod. — Stn DW 183, 280 m: 1 specimen, on *Chirona (Striatobalanus) amaryllis* (Darwin, 1854), latter attached to a sponge. — Stn CP 215, 485-520 m: 2 specimens. — Stn DW 221, 535-560 m: 1 specimen. — Stn DW 222, 410-440 m: 5 specimens. — Stn DW 223, 545-560 m: many specimens. — Stn DW 229, 445-460 m: many specimens, some attached to gastropod shell (MNHN-Ci 2695). Drawn; 1 specimen (MNHN-Ci 2391); 9 specimens, attached to gastropod shell (WAM C 23244); many specimens, attached to gastropod shells (WAM 251-96). — Stn DW 230, 390-420 m: 3 specimens.

SMIB 8: stn DW 167, 430-452 m: 1 specimen (WAM C 23245). — Stn DW 197, 414-436 m: 4 specimens. — Stn DW 198, 414-430 m: several specimens. — Stn DW 199, 408-410 m: 1 specimen, attached to gastropod.

BATHUS 2: stn DW 718, 430-436 m: several specimens, attached to brachiopod shells and echinoderm tests (WAM C 23246). — Stn DW 719, 444-455 m: many specimens (1 ovigerous), attached to gastropod shells and echinoderm

Source : MNHN, Paris

tests (WAM C 23247). — Stn DW 720, 530-541 m: 2 specimens (WAM C 23248); many specimens. — Stn DW 729, 400 m: many specimens. — Stn DW 738, 588-647 m: 1 specimen, attached to gastropod; 1 specimen.

BATHUS 4: stn CP 909, 516-558 m: 2 specimens, attached to shells of gastropods.

Loyalty Islands. BIOCAL: stn DW 44, 440 m: many specimens, attached to shells of gastropods and test of echinoderm. — Stn CP 45, 430-465 m: 17 specimens (6 juveniles), attached to fragment of test of echinoderm and shells of gastropods.

MUSORSTOM 6: stn CP 465, 480 m: 1 specimen, attached to fragment of echinoderm test. — Stn CP 466, 540 m: 2 specimens, attached to gastropods (USNM); 2 specimens. — Stn CP 467, 575 m: many specimens, some attached to shells of gastropods.

Norfolk Ridge. SMIB 2: stn DW 1, 438-444 m: several specimens on gastropod shell. — Stn DW 2, 438-448 m: 1 specimen (BMNH). — Stn DW 12, 445-460 m: 1 specimen, attached to shell of gastropod.

SMIB 3: stn DW 21, 525 m: 2 specimens. — Stn DW 22, 503 m: 12 specimens. — Stn DW 24, 525 m: 1 specimen; 1 specimen (broken). — Stn DW 25, 437 m: 3 specimens. — Stn DW 27, 457 m: 1 specimen.

SMIB 4: stn DW 58, 560 m: 11 specimens. — Stn DW 61, 550 m: 1 specimen. — Stn DW 64, 460 m: several specimens on gastropod shell. — Stn DW 65, 420 m: many specimens attached to gastropod shells. — Stn DW 68, 440 m: 3 specimens, attached to gastropod shells.

BATHUS 3: stn DW 829, 386-390 m: 1 specimen, attached to shell of gastropod (MNHN-Ci 2392). — Stn CP 833, 441-444 m: 11 specimens, attached to fragments of echinoderm test and shell of gastropod.

Futuna Island. MUSORSTOM 7: stn CP 505, 245-400 m: 1 specimen, attached to fragment of shell of gastropod.

Combe Bank. MUSORSTOM 7: stn DW 547, 455 m: 1 specimen.

Waterwich Bank. MUSORSTOM 7: stn DW 537, 325-400 m: 1 specimen, attached to shell of gastropod.

TYPES. — *Holotype*: MNHN-Ci 2391 (MUSORSTOM 4, stn DW 229).

Paratypes: BMNH (SMIB 2, stn DW 2). — MNHN-Ci 2392 (BATHUS 3, stn DW 829). — MNHN-Ci 2695 (MUSORSTOM 4, stn DW 229). Drawn. — USNM (MUSORSTOM 6, stn CP 466). — WAM 251-96 (MUSORSTOM 4, stn DW 229).

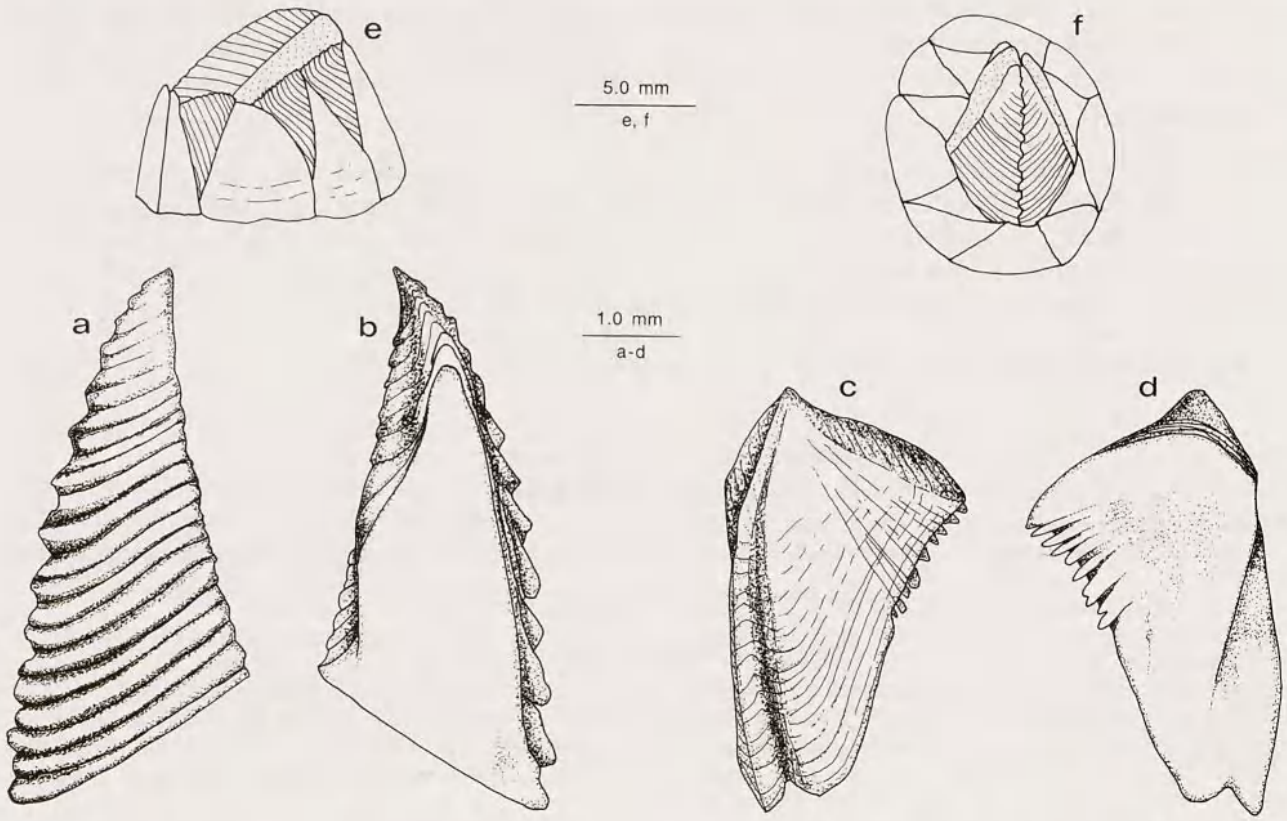

FIG. 9. — *Eutomolasma maclaughlinae* sp. nov. Paratype from MUSORSTOM 4, stn DW 229 (MNHN-Ci 2695): **a**, S, external view; **b**, S, internal view; **c**, T, external view; **d**, T, internal view; **e**, whole animal, lateral view; **f**, whole animal, from above.

Source : MNHN, Paris

DIAGNOSIS. — Form rounded oval from above; orifice smooth, large, diamond-shape. Basal width of R twice basal width of RL; rostral sutures visible externally. Basal width of CL^2 1/2 basal width of CL^1. Superior alar margin subparallel to basal margin, finely serrate. S elongate triangle, feebly convex externally. Articular ridge of T scarcely projecting; externally with 1 parallel, longitudinal ridge on each side of spur; 7-9 muscle crests extending beyond basal margin; T spur short.

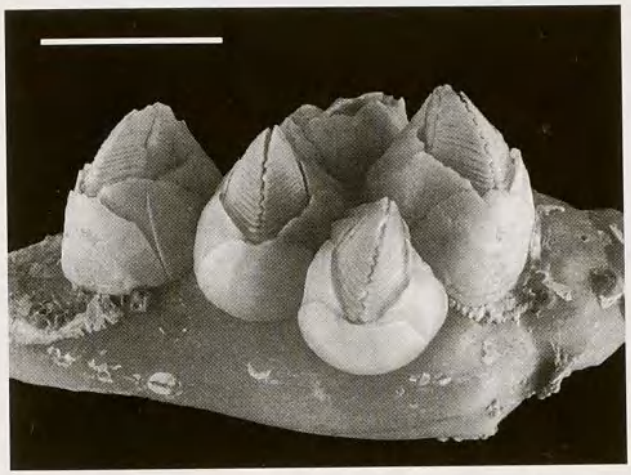

FIG. 10. — *Eutomolasma maclaughlinae* sp. nov. Paratypes from MUSORSTOM 4, stn DW 229 (WAM 251-96): oblique lateral view. Scale = 1cm.

DESCRIPTION. — Shell moderate sized (maximum: RC length 10.5, C height 8.2). Parietal plates with growth ridges barely visible, irregular, most developed on rostral plate. Rostral plate convex; basal width twice basal width of CL^1, height subequal to height of C; sutures between R and RL visible externally and internally. CL^1 and CL^2 separate; basal width of CL^1 subequal to basal width of R, twice width of CL^2. Basal width of CL^2 1/2 basal width of CL^1; CL^2 higher than CL^1 by 1/3. Height of C equal to or slightly higher than R, basal width equal to that of CL^1; apex sloping inward to orifice, not retroverted and spout-like. Alae of C, CL^1 and CL^2 subequal, broad, triangular; alar growth ridges regular, parallel to inferior alar margin. Basis membranous; flat. Opercular plates orientated from sub-parallel to basis to angle of 40° to basis. S elongate triangle, basal margin 7/15 length of occludent margin; apex acute; externally feebly convex, growth ridges regular, smooth, not cut by longitudinal striae; internally adductor muscle and lateral depressor muscle pits absent; articular furrow narrow; articular ridge long, extending 3/4 length of valve, not projecting beyond articular margin; adductor ridge indistinct. T similar size to S, sub-triangular; externally with fine growth ridges, fine longitudinal striations in carinal area, 2 parallel, longitudinal ridges, 1 either side of spur; internally with 7-9 distinct muscle attachment crests extending beyond basal margin; articular margin convex; articular ridge long, barely projecting beyond articular margin; articular furrow wide; spur short, rounded, 1/9 width of basal margin, set at its own width from basi-scutal angle. Color of parietal plates peachy orange, C and CL^2 deeper orange; shell sometimes pale ochre-orange or dirty cream color; opercular plates lemon yellow; eggs orange. Measurements of 10 specimens examined, randomly selected from several stations, as follows:

	RC length	LD	C height	R height
rg	7.7-10.5	7.2-11.0	3.8-8.2	4.7-8.2
$\bar{x}$	9.0	8.6	5.5	6.0

Labrum with shallow medial depression; small teeth present at edges of depression, teeth absent from central area. Mandibular palp club-shaped; dense, serrate setae terminally. Mandible with 3 teeth, tooth 1 largest, separated from teeth 2 and 3; upper margins of 2 and 3 with subsidiary cusps; inferior angle molariform, dentate. Maxillule with 1 pair of long, stout setae at upper angle; notch below upper angle 1/4 length of cutting margin, with 5-6 pairs of smaller setae; straight cutting margin below with 5-7 pairs of longer, stout setae; inferior angle slightly sinuous, with 5-6 pairs of smaller setae. Maxilla as wide as high, with long serrulate setae terminally.

Cirrus I with rami unequal; anterior ramus longer than posterior; proximal segments of anterior ramus barely protuberant anteriorly; both rami with segments moderately setose. Cirrus II longer than cirrus I; rami subequal, anterior ramus shorter than posterior; proximal segments of anterior ramus slightly protuberant anteriorly; distal segments of posterior ramus antenniform; all segments with dense, simple setae, some finely serrulate setae

Source : MNHN, Paris

distally. Cirrus III longer than cirrus II, rami subequal, segments becoming oblong distally; posterior ramus with 2-4 pairs of long, finely serrulate setae on anterior faces of distal segments; anterior ramus with 2-4 pairs of long, finely serrulate setae on anterior faces of more distal segments, proximal segments with 8 pairs. Cirrus IV to VI similar, longer than cirrus III; segments oblong, with 4 pairs of setae on anterior faces, distal 2 pairs longest, finely serrulate. Chaetotaxy ctenopod. Cirral formula as follows:

Paratype:		C I	C II	C III	C IV	C V	C VI	c. a.
MNHN	left	12, 8	14, 15	16, 18	22, 25	27, 27	28, 28	11+
Ci 2695	right	11, 8	14, 14	17, 19	15+, 25	27, 29	29, 28	17

Caudal appendages at least twice length of pedicel of cirrus VI; 11-17 segments; sparse circlet of long, fine setae apically and at distal borders of segments, setal length equal to segmental length. Penis subequal to cirrus VI; annulated, sparsely setose, with sparse circlet of long setae distally. Eggs large, 0.5 x 0.4 mm.

REMARKS. — *Eutomolasma maclaughlinae* sp. nov. differs from all other members of the genus by the large size of the R (basal width twice the basal width of RL); by CL^2 being higher, not shorter, than CL^1; and by T possessing 2 external longitudinal ridges, 1 each side of the spur. It is further separated from *E. chinense* by the membranous rather than calcareous basis, by the rostral plate sutures being visible externally rather than being inconspicuous, by the absence of an epicuticle, rather than a thin, yellowish epicuticle covering the parietal plates; and by the color of the parietal plates (peachy orange or pale ochre/orange to dirty cream rather than white tinted with pink apically).

The new species is similar to *E. orbiculatum* sp. nov. as both species have a convex tergal articular margin (more pronounced in *E. orbiculatum*), but *E. maclaughlinae* may be separated from *E. orbiculatum* as follows: by its smaller size (maximum: RC length 10.5, RC length 23.0, respectively), by the basal width of CL^2 being 1/2 that of CL^1 rather than 1/4-1/5; by the T articular ridge scarcely projecting, rather than extending well beyond the articular margin; by the length of the caudal appendages (at least twice the height of the pedicel of cirrus VI rather than longer than the pedicel of cirrus VI by 1/4); and by the dentition of the labrum (small teeth present at the edges of the median depression, rather than absent).

Eutomolasma japonicum differs from *E. maclaughlinae* sp. nov. in C being the shortest of all the plates (rather than equal to or higher than R), by the basal width of R being equal to, rather than twice, the basal width of RL; by the basal width of CL^2 being less than 1/2 that of CL^1, rather than 1/2; by the height of CL^2 being 8/9 the height of CL^1 rather than higher than CL^1 by 1/3; by the T spur being indistinct rather than short and rounded; and by the color (glossy pink parietal plates, fading toward a whitish R, rather than peachy orange or pale ochre/orange).

ETYMOLOGY. — Named in honour of my friend and colleague Dr Patsy A. McLAUGHLIN, in recognition of her contributions to cirripedology, and who first noted this species on mollusc shells inhabited by hermit crabs.

DISTRIBUTION. — Chesterfield Islands, 500-510 m; New Caledonia, 280-647 m; Loyalty Islands, 430-575 m; Norfolk Ridge, 386-560 m; Futuna Island, 245-400 m; Combe Bank, 455 m; Waterwich Bank, 325-400 m.

Eutomolasma orbiculatum sp. nov.

Figs 8, 12-14; Tables 5-6

MATERIAL EXAMINED. — **Loyalty Islands**. BIOCAL: stn DW 83, 460 m: 3 specimens (MNHN-Ci 2393, Ci 2696). Drawn.

Norfolk Ridge. SMIB 4: stn DW 55, 260 m: 13 specimens (ontogenetic series), attached to *Petrotrochus caledonicus* Bouchet & Métivier (WAM 252-96). — Stn DW 68, 440 m: 1 specimen (MNHN-Ci 2394).

Source : MNHN, Paris

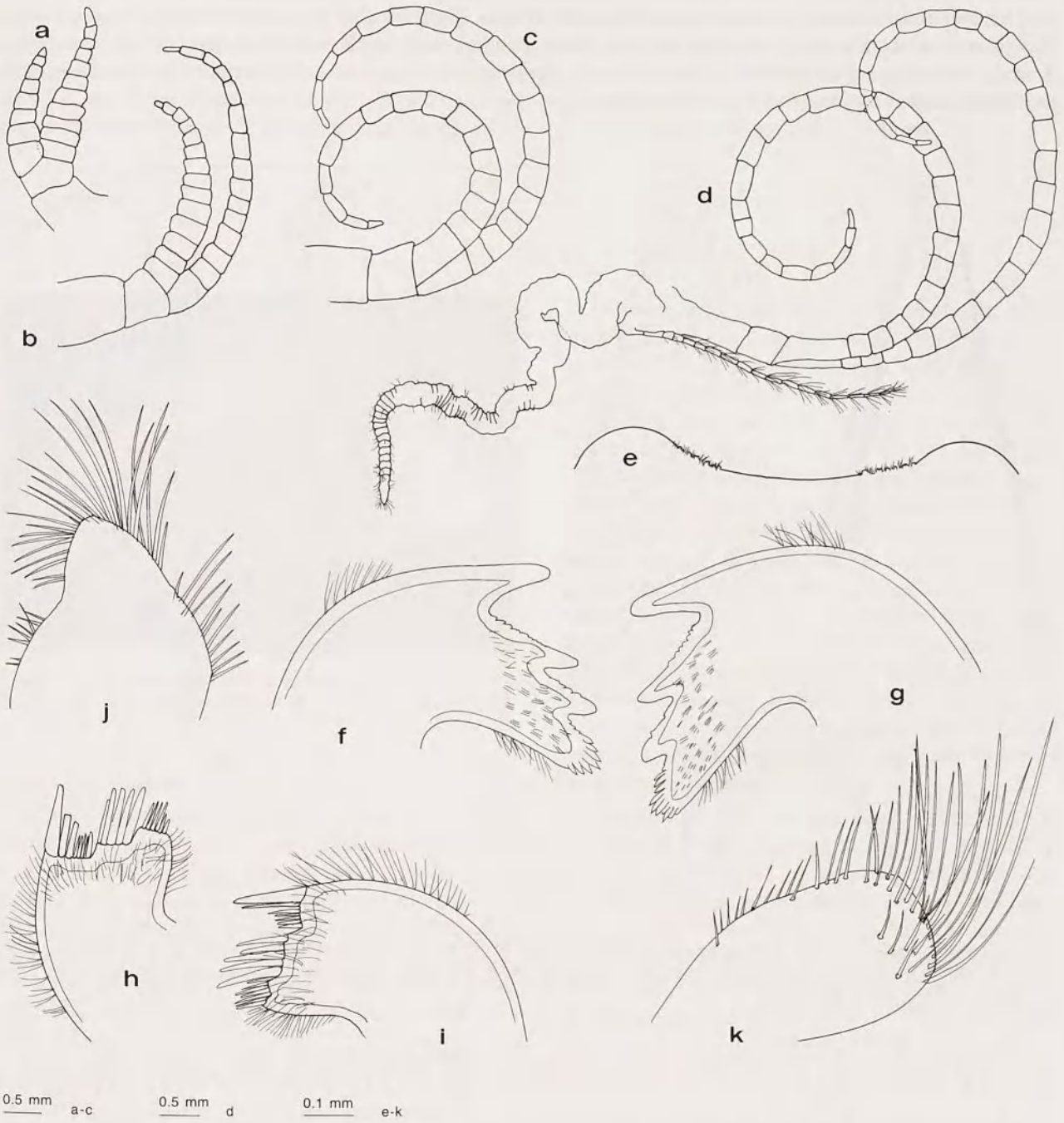

FIG. 11. — *Eutomolasma maclaughlinae* sp. nov. Paratype from MUSORSTOM 4, stn DW 229 (MNHN-Ci 2695): **a**, cirrus I; **b**, cirrus II; **c**, cirrus III; **d**, cirrus VI, penis and caudal appendage; **e**, labrum; **f**, right mandible; **g**, left mandible; **h**, right maxillule; **i**, left maxillule; **j**, maxilla; **k**, mandibular palp.

TYPES. — *Holotype*: MNHN-Ci 2393 (BIOCAL, stn DW 83).

Paratypes: MNHN-Ci 2394 (SMIB 4, stn DW 68). — MNHN-Ci 2696 (BIOCAL, stn DW 83). Drawn. — WAM 252-96 (SMIB 4, stn DW 55).

Source : MNHN, Paris

DIAGNOSIS. — Shell large (maximum: RC length 23.0, C height 9.6); basal circumference subcircular. Orifice smooth, rounded pentagonal. Parietal plates smooth, growth ridges faint. Basal width of R equal to basal width of RL; rostral sutures visible externally and internally. Basal width of CL^2 1/4-1/5 basal width of CL^1. Alae triangular, superior alar margins slightly serrate. Basis membranous; flat. S convex externally. T articular ridge strongly projecting; spur indistinct; externally with longitudinal ridge close to S margin; 15-18 small muscle attachment ridges extending just beyond basal margin.

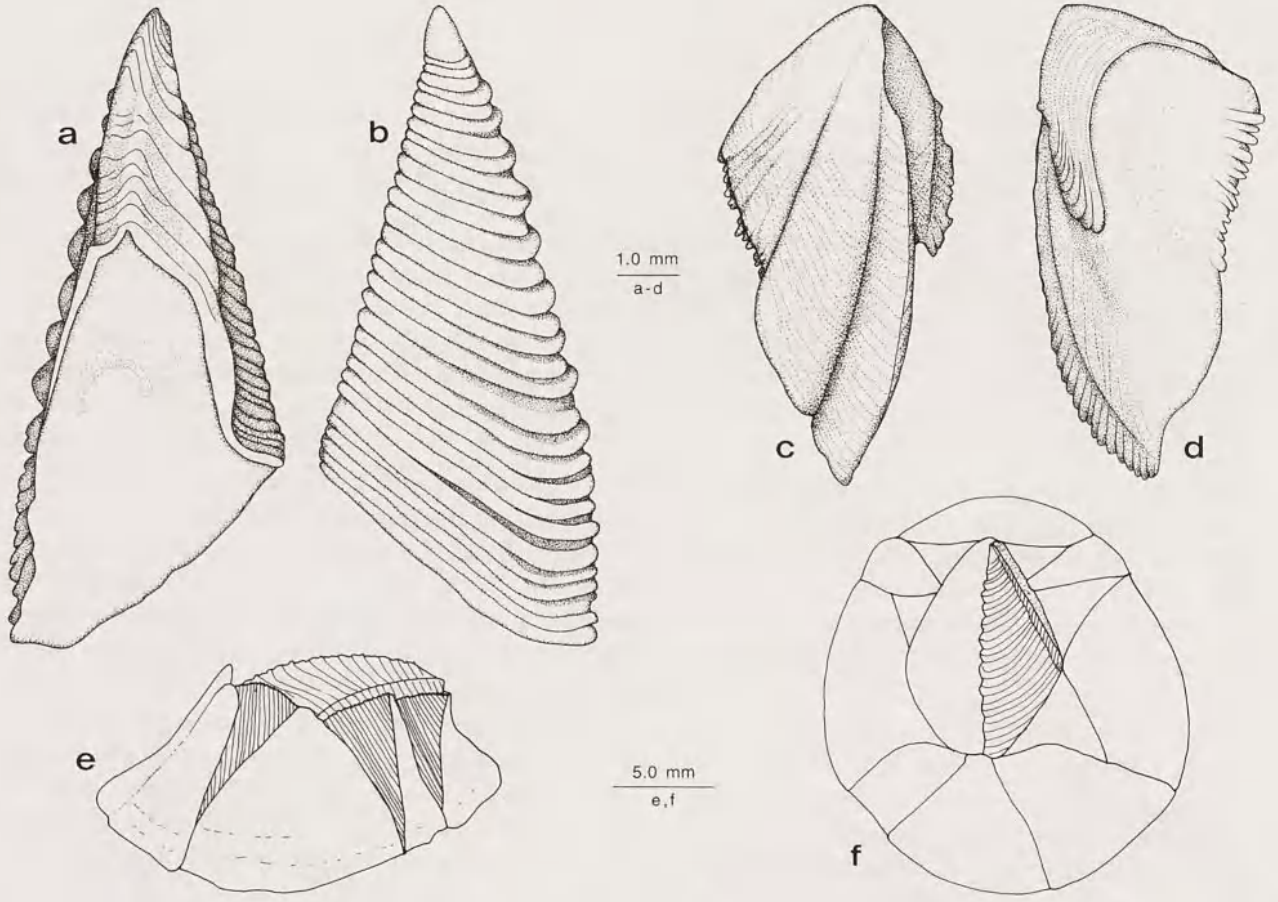

FIG. 12. — *Eutomolasma orbiculatum* sp. nov. Paratype from BIOCAL, stn DW 83 (MNHN-Ci 2696): **a**, S, internal view; **b**, S, external view; **c**, T, external view; **d**, T, internal view; **e**, whole animal, lateral view; **f**, whole animal, from above (right S and T removed).

DESCRIPTION. — Parietal plates smooth, growth ridges faint. Rostral plate convex, largest plate; sutures between R and RL visible internally and externally, dividing plate into 3, basal width of R equal to basal width of RL. Basal width of CL^1 subequal to that of rostral plate; CL^2 smallest plate; basal width of CL^2 1/4 to 1/5 basal width of CL^1; height of CL^2 4/5 height of CL^1. C convex; narrower than CL^1 and rostral plate, wider than CL^2; shorter than or subequal to height of R. Alae triangular, those of CL^1 widest, alae of CL^2 2/3 width of alae of CL^1, alae of C 1/3 width of alae of CL^1; superior alar margins slightly serrate; alar growth ridges parallel to inferior alar margin, faintly marked. Basis membranous; flat. Orifice large, roundly pentagonal; not toothed. Opercular plates lodged sub-parallel to basis. S convex externally, elongate triangle, occludent margin twice length of basal margin; apex acute; externally with regular, smooth, transverse growth ridges not cut by longitudinal striae; internally adductor muscle pit faint, at slightly less than 1/2 height of valve; lateral depressor muscle pit absent; articular furrow narrow, shallow; articular ridge extending 3/4 length of valve, not projecting beyond

Source : MNHN, Paris

articular margin; adductor ridge absent. T 2/3 size of S; externally growth ridges faint, except in area of articular ridge (visible when whole animal viewed from above), with longitudinal ridge set at distance of 1/5 width of basal margin from S margin; internally with 15-18 weak muscle crests projecting slighty beyond basal margin; articular margin distinctly convex; articular ridge prominent, projecting beyond articular margin; articular furrow well-developed; spur indistinct, width 1/4 width of basal margin, set at distance of 1/5 width basal margin from basi-scutal angle. Color of parietal plates pale yellow/cream with some ochre/orange on C and CL[2]; opercular plates cream. Measurements of 10 specimens examined, randomly selected from several stations, as follows:

	RC length	LD	C height	R height
rg	4.4-23.0	4.3-29.9	1.7-9.6	1.8-9.0
$\bar{x}$	12.1	13.1	4.6	0.44

FIG. 13. — *Eutomolasma orbiculatum* sp. nov. Holotype, BIOCAL, stn DW 83 (MNHN-Ci 2393): lateral view. Scale = 1 cm.

Labrum with shallow, small teeth absent; dense patch of stiff, small, downwardly pointing setae on either side of medial depression. Mandibular palp broadly ovate; long serrate setae terminally. Mandible with 3 teeth, equally sized, equally separated; upper margin of teeth 2 and 3 with few weak subsidiary cusps; inferior angle large, bluntly molariform, strongly dentate. Maxillule setose; several long, stout setae at upper angle; notch below upper angle ill-defined, with 4-6 pairs of smaller setae; cutting margin below irregular or slightly stepped, with 7-8 pairs of longer, stout setae; inferior angle sinuous, with 9-10 pairs of small setae. In illustrated specimen left mandible showing following variations — notch barely defined; stout, serrulate setae interspersed between stout setae on cutting margin; inferior angle small, with 4 pairs of small setae. Maxilla wide, coxal endite well-developed; setae long, dense, simple or serrulate.

Cirrus I with rami unequal; anterior ramus longer than posterior; proximal segments of anterior slightly protuberant anteriorly; both rami with segments setose; postero-distal angles of segments of both rami with small tufts of simple and finely serrulate setae, surface of segments with combs of small, simple setae. Cirrus II longer than cirrus I; rami unequal, anterior ramus shorter than posterior; proximal segments of anterior broader than those of posterior and slightly protuberant anteriorly; distal segments of posterior ramus antenniform; all segments with simple and finely serrulate setae, serrulate setae distally. Cirrus III longer than cirrus II; rami subequal, segments becoming oblong distally; posterior ramus with 2-4 pairs of long, finely serrulate setae on anterior faces of distal segments; anterior ramus with 2-4 pairs of long, finely serrulate setae on anterior faces of distal segments, proximal segments with 10 pairs. Cirrus IV to VI similar, longer than cirrus III; segments oblong, with 4 pairs of setae on anterior faces, distal 2 pairs of setae longest, finely serrulate. Chaetotaxy ctenopod. Cirral formula as follows:

Paratype:		C I	C II	C III	C IV	C V	C VI	c. a.
MNHN	left	13, 11	12, 18	19, 21	20, 28	27, 27	28, 29	14
Ci 2696	right	13, 10	15, 15	18, 20	22, 25	29, 27	28, 28	15

Caudal appendages longer than pedicel of cirrus VI by 1/4 length of pedicel of cirrus VI; 14-15 segments; sparse, long, fine setae apically and around distal margins of segments. Penis 1/4 length of cirrus VI; finely annulated; sparsely setose, with circlet of dense long setae distally.

Source : MNHN, Paris

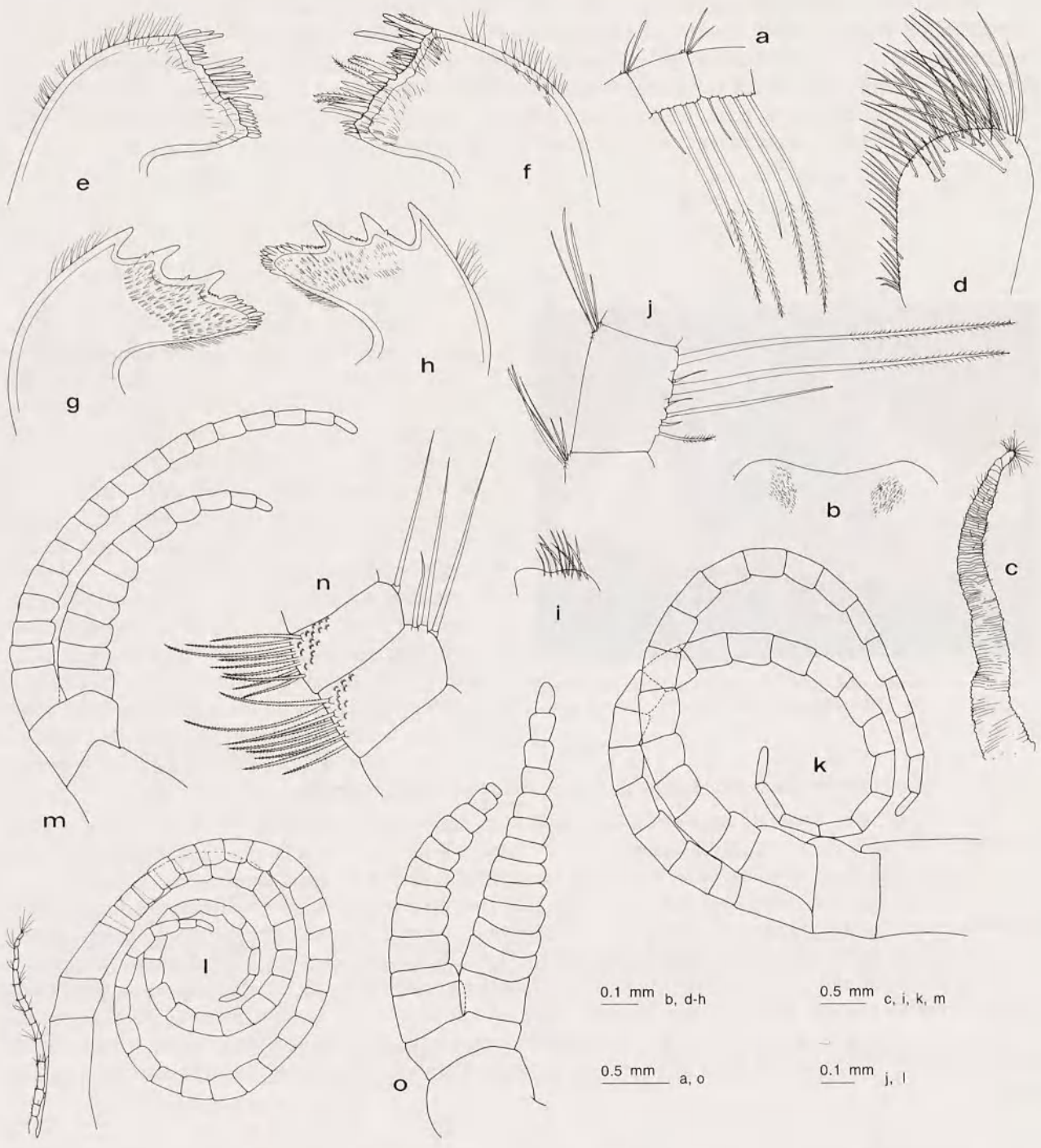

FIG. 14. — *Eutomolasma orbiculatum* sp. nov. Paratype from BIOCAL, stn DW 83 (MNHN-Ci 2696): **a**, cirrus VI, posterior ramus, median segment; **b**, labrum; **c**, penis; **d**, mandibular palp; **e**, right maxillule; **f**, left maxillule; **g**, right mandible; **h**, left mandible; **i**, maxilla; **j**, cirrus III, posterior ramus, median segment; **k**, cirrus III; **l**, cirrus VI and caudal appendage; **m**, cirrus II; **n**, cirrus I, posterior ramus, median segments; **o**, cirrus I.

REMARKS. — The strongly projecting tergal articular ridge, the 15-18 weak muscle crests projecting slightly beyond the tergal basal margin and the externally convex S characterise *Eutomolasma orbiculatum* sp. nov.

Source : MNHN, Paris

The species is similar to *E. japonicum*, but may be distinguished from that species by the narrow secondary CL^2, whose basal width is 1/4-1/5, rather than less than 1/2, the basal width of CL^1; by the basis being totally membranous rather than calcareous at the edges and membranous centrally; by features of the S, which in *E. orbiculatum* is convex externally, with the basal margin 1/2 the length of the occludent margin, and feebly convex, with the basal margin less than 1/2 the length of the occludent margin in *E. japonicum*; by the T having a convex articular margin and a prominent articular ridge extending well beyond the articular margin (*E. orbiculatum*) rather than a straight articular margin and a scarcely projecting articular ridge (*E. japonicum*); by the relative lengths of the caudal appendages, being longer than the pedicel of cirrus VI by 1/4 the height of the pedicel of cirrus VI (14-15 segments) rather than twice the height of the pedicel of cirrus VI (13-14 segments); and by the color - parietal plates pale yellow-cream with some ochre-orange (*E. orbiculatum*), rather than glossy pink (*E. japonicum*). The new species differs from *E. maclaughlinae* sp. nov. in size, in the overall shell form and in the soft part morphology (see remarks under *E. maclaughlinae*).

Eutomolasma orbiculatum sp. nov. may be distinguished from *E. chinense* by the rostral sutures being visible externally and internally, rather than inconspicuous; by the basal width of CL^2 being 1/4-1/5 the basal width of CL^1 rather than 1/2 the basal width of CL^1; by the membranous rather than calcareous basis; by the tergal articular ridge strongly projecting, rather than not projecting; and by the color of the parietal plates — pale yellow/cream with some ochre/orange, rather than white with pink apices and covered with a yellowish epicuticle.

ETYMOLOGY. — From the Latin *orbiculatum*, "circular", in reference to the circular circumference of the shell.

DISTRIBUTION. — Loyalty Islands, 460 m; Norfolk Ridge, 260-440 m.

Genus ***MICROLASMA*** gen. nov.

Fig. 15; Tables 3-4, 7-8

DIAGNOSIS. — Adult with fixed shell pattern of 6 weakly articulated, thin parietal plates (R-CL^1-CL^2-C). Rostral plate compound, sutures visible, basal widths of R and RL subequal. CL^1 and CL^2 separate. S externally flat, as wide as high, with smooth, even transverse growth ridges, not cut by longitudinal striae. Caudal appendage length ranging from less than height of basal segment of pedicel of cirrus VI to slightly longer than pedicel of cirrus VI, 6-9 segments.

TYPE SPECIES. — *Microlasma fragile* sp. nov.

RECENT SPECIES. — *Microlasma arwetergum* (Rosell, 1991); *M. crinoidophilum* (Pilsbry, 1911); *M. fragile* sp. nov.; *M. ochriderma* (Foster, 1981).

REMARKS. — *Microlasma* gen. nov. is similar to *Eutomolasma* gen. nov. as both have an adult fixed wall pattern of 6 plates, a compound rostral plate with visible sutures and CL^1 and CL^2 as separate entities. However, the genera may be distinguished by characters of the S and the caudal appendages. The S of *Microlasma* is as wide as high and is flattened, that of *Eutomolasma* is elongated, narrow and convex externally. The caudal appendages of *Microlasma* are 6-9 segmented and small, ranging from less than the height of the proximal segment of the pedicel of cirrus VI to just longer than the pedicel of cirrus VI, whereas those of *Eutomolasma* are 11-17 segmented and long (longer than the pedicel of cirrus VI by 1/4 the height of the pedicel of cirrus VI, to at least twice the height of the pedicel of cirrus VI). Other distinguishing characters are listed in Tables 3, 4, 7 and 8.

The species included within *Microlasma* gen. nov. are relatively small (maximum: RC length 9.0, LD 6.2, C height 7.0, R height 2.6). Ovigerous specimens of *M. arwetergum* have an RC length of 4.2 and those of *M. fragile* sp. nov. 5.3. The species occur in association with animal substrates — e.g., *M. arwetergum* and *M. crinoidophilum* with crinoids, *M. ochriderma* with gorgonians, and *M. fragile* with gorgonians and sponges, but further records may show these associations to be purely facultative.

Source : MNHN, Paris

TABLES 7 and 8: *Microlasma* gen. nov.: characters of the species

	no. plates ext.	no. plates int.	R:RL	CL^1: CL^2	T	basis
M. arwetergum (Rosell, 1991)	6	8	R = RL	separate; CL^2 = 1/4 basal width CL^1; CL^2 sharply tapering; CL^2 shorter than CL^1 by 1/5	artic. ridge projecting, broad; unique arrow shape, spur 1/2 height of valve, 2/9 width of basal margin; set at 1/9 length of basal margin from b-s scutal angle; 3-5 muscle crests proj. from basal margin	membranous
M. crinoidophilum (Pilsbry, 1911)	6	8	R = RL	separate; CL^2 = 1/2 basal width CL^1; CL^2 sharply tapering; CL^2 shorter than CL^1 by 1/5	artic. ridge projecting; spur short, 2/5 width of basal margin; set at 1/10 length of basal margin from b-s scutal angle; 5-6 muscle crests proj. from basal margin; ext. with long. depression running along S border	membranous
M. fragile sp. nov.	6	8	R = RL	separate; CL^2 = 1/2-1/3 basal width CL^1; height CL^2 = height CL^1	artic. ridge projecting; spur 1/2 height of valve, roundly truncate, 1/5 width of basal margin; set at 1/8 length of basal margin from b-s angle; 6-8 muscle crests proj. from basal margin	membranous
M. ochriderma (Foster, 1981)	6	8	R = RL	separate; CL^2 = 2/3 basal width CL^1; CL^2 = height CL^1	artic. ridge projecting; spur short,1/2 width of basal margin; set at 1/10 length of basal margin from b-s angle; 5-7 muscle crests proj. from basal margin	membranous

artic. = articular; b-s = basi-scutal; ext. = external; int. = internal; proj. = projecting.

	S shape	S growth lines	c.a.	mandible	size (max.)	distribution	depth
M. arwetergum (Rosell, 1991)	S transversly elongated; basal margin 5/7 length of occludent margin; artic. ridge proj.	smooth, even, transverse, not cut by long. striae	7-9 segments; slightly longer than pedicel of CVI	tridentate; upper margins of teeth 3 and/or 2 with small subsidiary cusps	RC length 5.0, ovigerous at RC length 4.2	Philippines	120-123 m
M. crinoidophilum (Pilsbry, 1911)	S width = 1/2 S length; basal margin 2/3 length of occludent margin; artic. ridge proj.	smooth, even, transverse, not cut by long. striae	8 segments; < 1/2 height of basal segment of pedicel of CVI	tridentate; upper margins of teeth 3 and/or 2 often with small subsidiary cusps	RC length 9.0 C height 7.0	E China Sea, Japan	274-400 m
M. fragile sp. nov.	S as wide as high; basal margin 7/10 length of occludent margin; artic. ridge proj.	smooth, even, transverse, not cut by long. striae	6-7 segments; slightly longer than basal segment of pedicel of CVI	tridentate; upper and lower margins of teeth smooth	RC length 5.3 C height 3.0 , ovigerous at RC length 5.3	Loyalty Is	245 m
M. ochriderma (Foster, 1981)	S as wide as high; basal margin 2/3 length of occludent margin; artic. ridge proj.	smooth, even, transverse, cut by few faint, long. striae	7 segments; = to height of basal segment of pedicel of CVI	tridentate; upper margins of teeth smooth; teeth sharp, curved	RC length 7.8	Norfolk I.	392-423 m

artic. = articular; c.a. = caudal appendage; long. = longitudinal; max. = maximum; proj. = projecting.

ETYMOLOGY. — From the Greek *mikros*, "small", in reference to the small size of the species which constitute this genus.

Source : MNHN, Paris

DISTRIBUTION. — Western Pacific Ocean. East China Sea, Japan, 274-400 m (*M. crinoidophilum*); Philippines, 120-123 m (*M. arwetergum*); Norfolk I., 392-423 m (*M. ochriderma*); Loyalty Islands, 245 m (*M. fragile*).

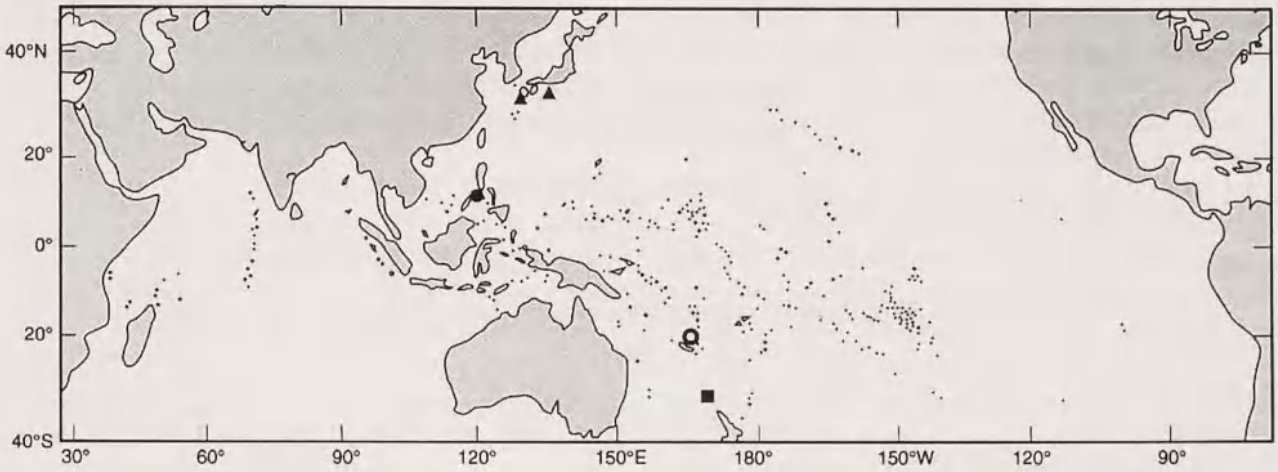

FIG. 15. — *MICROLASMA* gen. nov. Distribution map: ▲, *M. crinoidophilum* (274-400 m); ●, *M. arwetergum* (120-123 m); ○, *M. fragile* (245 m); ■, *M. ochriderma* (392-423 m).

Microlasma arwetergum (Rosell, 1991)

Fig. 15; Tables 7-8

Pachylasma arwetergum Rosell, 1991: 35, figs 6 j-k, 8 f-h, 9 a-f.

MATERIAL EXAMINED. — **Philippines**. MUSORSTOM 3: stn 124, 12°02.6'N, 121°35.3'E, 120-123 m: holotype (MNHN-Ci 2103).

TYPES. — *Holotype*: MNHN Ci 2103; Philippines, MUSORSTOM 3, stn 124, 12°02.6'N, 121°35.3'E, 120-123 m; attached to cirri of crinoids, with *Heteralepas cornuta* (Darwin, 1851).

Paratypes: MNHN Ci 2104; Philippines, MUSORSTOM 3: stn 124, 12°02.6'N, 121°35.3'E, 120-123 m. — UPIBM Crust. Coll. No. 372; Philippines, MUSORSTOM 3: stn 124, 12°02.6'N, 121°35.3'E, 120-123 m.

Holotype depository: MNHN.

Paratypes depository: MNHN, UPIBM.

DIAGNOSIS. — Shell conical, more or less elongated along rostrocarinal axis. CL^2 sharply tapering, apex so narrow that apex of CL^1 almost touches C; basal width of CL^2 1/4 basal width of CL^1; CL^2 shorter than CL^1 by 1/5. C deeply concave, almost V-shaped. S transversely elongated towards basioccludent angle; S basal margin 5/7 length of occludent margin, S articular ridge projecting. T smaller than S, arrow-shaped; long spur 1/2 height of valve, width 2/9 width of basal margin, set at distance of 1/9 length of basal margin from basi-scutal angle; 3-5 muscle crests projecting beyond basal margin. Mandible with 3 teeth, upper margin of tooth 3 and/or 2 with small subsidiary cusps. Caudal appendages slightly longer than pedicel of cirrus VI, 7-9 segments.

REMARKS. — This species (maximum RC basal diameter 5.0; ovigerous specimens RC length 4.2) is distinguished from all others in the genus by the unique, arrow-shape of the T, produced by the long T spur and a deep incision on the tergal basal margin, and by the pinkish-brown color of the parietal plates. *Microlasma arwetergum* resembles *M. crinoidophilum*, as both species have small, sharply tapering CL^2 (1/4 the basal width and 1/2 the basal width of CL^1, respectively), the apices of which are shorter than the apices of CL^1. The caudal appendages of *M. arwetergum* are 7-9 segmented and are longer than the pedicel of cirrus VI,

Source : MNHN, Paris

whilst those of *M. crinoidophilum* are 8-segmented and not as long as the basal segment of the pedicel of cirrus VI. *Microlasma arwetergum* is a smaller species than *M. crinoidophilum* (maximum RC length 5.0, 9.0, respectively).

Microlasma arwetergum differs from *M. fragile* sp. nov. and *M. ochriderma* as both the latter have CL^2 (basal width of CL^2 1/2 to 1/3 basal width CL^1, basal width of CL^2 2/3 basal width CL^1, respectively) which do not taper narrowly and whose height equals the height of CL^1. Differences between *M. arwetergum* and *M. fragile* sp. nov. are listed under *M. fragile*. The caudal appendages of *M. ochriderma* are shorter (equal to the height of the basal segment of the pedicel of cirrus VI, 7-segmented) than those of *M. arwetergum* (longer than the pedicel of cirrus VI, 7-9 segmented).

DISTRIBUTION. — Philippines, 120-123 m.

Microlasma crinoidophilum (Pilsbry, 1911)

Fig. 15; Tables 7-8

Pachylasma crinoidophilum Pilsbry, 1911: 81, fig. 11, pl. 17 figs 1-11; 1916: 329. — KRÜGER, 1911: 460. — NILSSON-CANTELL, 1932: 14, fig. 5, pl. 1 figs 1-2. — UTINOMI, 1958: 307; 1968: 24, fig. 3. — NEWMAN & ROSS, 1976: 40. — ROSELL, 1991: 37.

MATERIAL EXAMINED. — **Japan**. *"Albatross"*: stn 4934: off Sala Misaki, Kagoshima Gulf, 274-400 m, 16.08.1906: holotype (USNM 3867).

TYPES. — *Holotype*: USNM 38675; Japan, *"Albatross"*: stn 4934, off Sala Misaki, Kagoshima Gulf, 274-400 m, 16.08.1906; dry (1 lot) and wet (1 lot).
Holotype depository: USNM.

DIAGNOSIS. — Shell basal contour oblong. C and CL^1 largest plates; CL^2 shorter than CL^1 by 1/5, apices of former tapering abruptly, so that alae of CL^1 almost touch alae of C; basal width of CL^2 1/2 basal width of CL^1. C vertical, other parietal plates sloping inward. S width equal to 1/2 S length, S basal margin 2/3 width of occludent margin, articular ridge projecting. T externally with longitudinal depression running along S border; spur short, 2/5 width of basal margin, set at distance of 1/10 length of basal margin from basi-scutal angle; 5-6 muscle crests projecting from basal margin. Mandible with 3 teeth, upper margins of teeth 3 and 2 often with small subsidiary cusps, inferior angle dentate. Caudal appendages less than 1/2 height of basal segment of pedicel of cirrus VI, 8 segments.

REMARKS. — The species is small (maximum: RC length 9.0, C height 7.0). Differences between *M. crinoidophilum* and *M. arwetergum*, and between *M. crinoidophilum* and *M. fragilis* sp. nov., are listed under *M. arwetergum* and *M. fragilis* sp. nov., respectively.

Microlasma crinoidophilum differs from *M. ochriderma* in the form of CL^2. In *M. crinoidophilum* CL^2 is sharply tapering and shorter than CL^1 by 1/5, whereas in *M. ochriderma* CL^2 and CL^1 are equal in height, and the apex of CL^2 does not taper narrowly. The basal width of CL^2 is 1/2 the basal width of CL^1 in *M. crinoidophilum* whereas it is 2/3 the basal width of CL^1 in *M. ochriderma*. The T of *M. crinoidophilum* has a longitudinal depression running along the S border and the tergal spur is 2/5 the width of the basal margin, whilst the T of *M. ochriderma* has no longitudinal depression and the tergal spur is 1/2 the width of the basal margin. The caudal appendages of *M. crinoidophilum* are 8-segmented and are less than 1/2 the height of the basal segment of the pedicel of cirrus VI, whilst those of *M. ochriderma* are 7 segmented and equal to the height of the basal segment of the pedicel of cirrus VI. The mandibular teeth of *M. ochriderma* are curved and smooth, whereas those of *M. crinoidophilum* are not curved and the upper margins of teeth 2 and 3 may have small subsidiary cusps.

DISTRIBUTION. — East China Sea, Japan, 274-400 m.

Source : MNHN, Paris

Microlasma fragile sp. nov.

Figs 15-18; Tables 7-8

MATERIAL EXAMINED. — **Loyalty Islands**. MUSORSTOM 6: stn DW 421, 245 m: 3 specimens, ovigerous (large orange eggs), attached to sponge (MNHN-Ci 2395, Ci 2396). Drawn.

TYPES. — *Holotype*: MNHN-Ci 2395 (MUSORSTOM 6, stn DW 421).
Paratypes: MNHN-Ci 2396 (MUSORSTOM 6, stn DW 421). Drawn.

DIAGNOSIS. — Shell form upright; fragile, parietal plates thin, weakly articulated. Basal width of CL^2 1/2 to 1/3 basal width of CL^1; height of CL^2 equal to height of CL^1. C almost V-shaped. S as wide as high; articular ridge extending 2/3 length of tergal margin, projecting. Tergal spur 1/2 height of valve, 1/5 width of basal margin, set at 1/8 length of basal margin from basi-scutal angle; 6-8 muscle crests projecting from basal margin. Mandible with 3 teeth, margins of teeth smooth. Caudal appendages slightly longer than basal segment of pedicel of CVI, 6-7 segmented.

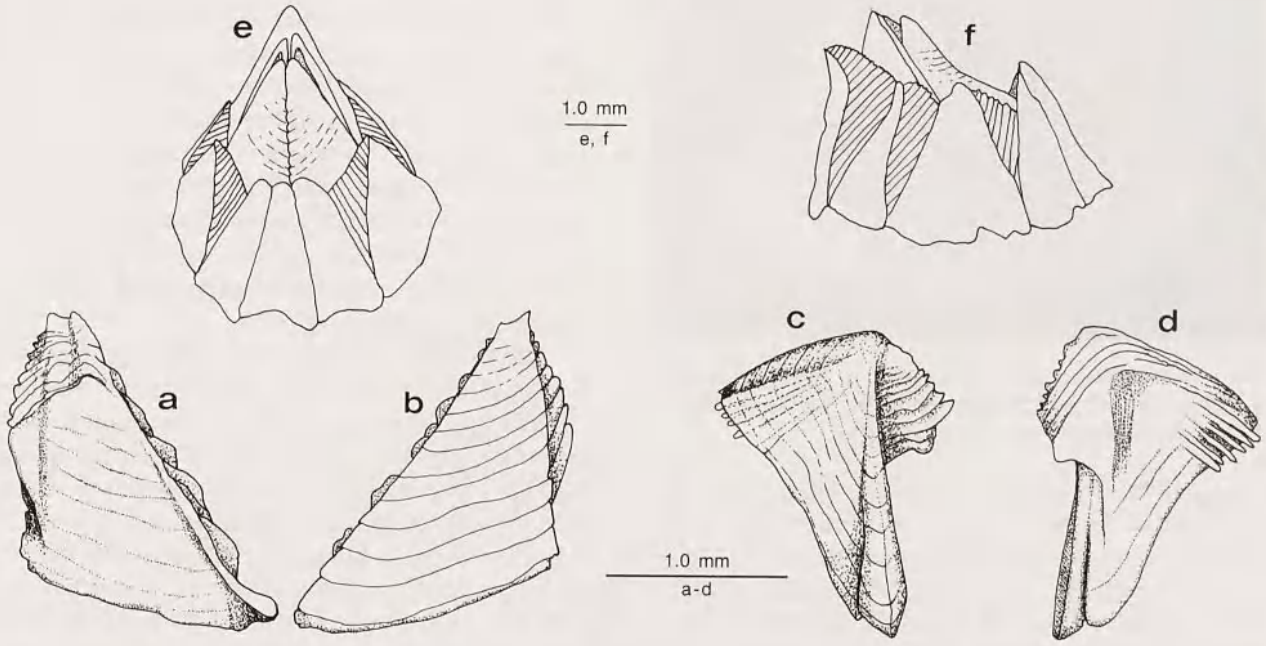

FIG. 16. — *Microlasma fragile* sp. nov. Paratype (ovigerous) from MUSORSTOM 6, stn DW 421 (MNHN-Ci 2396): **a**, S, internal view; **b**, S, external view; **c**, T, external view; **d**, T, internal view; **e**, whole animal, from above; **f**, whole animal, lateral view.

DESCRIPTION. — Size small (maximum: RC length 5.3, C height 3.0). Shell form upright, rostral plate and CL^1 sloping in toward orifice, apex of CL^2 pointing toward C. Parietal plates thin, fragile, weakly articulated; growth ridges fine, irregular, marked by minute setae. Rostral plate broad, convex; sutures between R and RL visible internally and externally, dividing plate into 3 subequal parts. CL^1 and CL^2 separate; CL^1 as broad as R. C deeply concave, apex spout-like, retroverted; higher than and subequal to width of R. Alae wide, those of C widest, those of CL^1 and CL^2 subequal, 1/2 width of carinal ala; superior alar margins finely serrate; alar growth ridges parallel to inferior alar margin. Basis membranous; flat. Orifice large, pentagonal, toothed. Opercular plates placed approximately 30° to basis. S flat, thin; triangular, as wide as high, basal margin 7/10 length of occludent margin; externally with well-spaced, even growth ridges, not convoluted or sinuous, not cut by longitudinal striae; internally adductor muscle and lateral depressor muscle pits absent; articular furrow narrow; articular ridge

Source : MNHN, Paris

extending 2/3 length of valve, projecting well beyond articular margin; adductor ridge absent. T thin; subtriangular, smaller than S by 1/4; externally growth ridges fine, some longitudinal striations in carinal area; internally with 6-8 fine muscle crests projecting beyond basal margin; articular ridge prominent, extending well beyond articular margin; articular furrow well-developed; spur roundly truncate, length 1/2 length of basal margin, set at distance of 1/8 length of basal margin from basi-scutal angle, width 1/5 length of basal margin. Color of parietal and opercular plates orange-ochre; eggs orange. Measurements of 3 specimens measured as follows:

	RC length	LD	C height	R height
Holotype: MNHN-Ci 2395	4.5	3.7	1.7	1.6
Paratypes: MNHN-Ci 2396	5.3	4.2	3.0	2.6
"	4.8	3.9	2.2	1.9

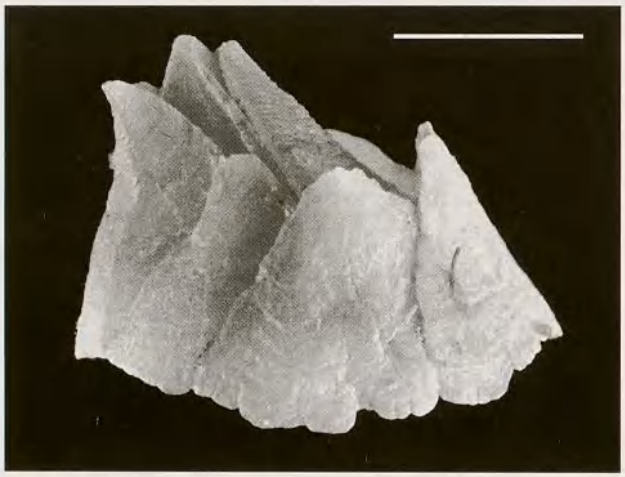

FIG. 17. — *Microlasma fragile* sp. nov. Holotype (ovigerous) from MUSORSTOM 6, stn DW 421 (MNHN-Ci 2395): lateral view. Scale = 1 cm.

Labrum with shallow medial depression, with regular row of small, spaced teeth, some bidentate. Mandibular palp oblong, narrow; long, serrate setae terminally. Mandible with 3 teeth, tooth 1 largest, well separated from teeth 2 and 3; margins of teeth smooth; inferior angle moderately large, bluntly molariform, strongly dentate. Maxillule setose; 2 long, stout setae at upper angle; notch below upper angle wide, 1/4 length of cutting margin, with 3-4 pairs of smaller setae; stepped cutting margin below with 3-4 pairs of longer, stout setae; stepped inferior angle with 4-6 pairs of small setae. Maxilla moderately wide, coxal endite barely developed; setae simple and serrulate, long, dense.

Cirrus I with rami unequal; anterior ramus longer than posterior; proximal segments of anterior slightly protuberant anteriorly; both rami with segments thickly setose, setae simple, stout; postero-distal angles of segments of posterior ramus with small tufts of stout setae, surface with combs of small, simple setae. Cirrus II longer than cirrus I, similar form to posterior cirri; rami subequal; proximal segments of anterior ramus broader than those of posterior ramus, slightly protuberant anteriorly, all segments setose, especially distally, setae simple or serrulate; posterior ramus antenniform, segments becoming elongated and narrow distally, distal segments with 4-5 pairs of long, finely serrulate setae on anterior faces. Cirrus III similar to cirri IV-VI; rami subequal, segments becoming oblong distally; posterior ramus with 2-5 pairs of long, finely serrulate setae on anterior faces of distal segments; anterior ramus with 2-3 pairs of long, finely serrulate setae on anterior faces distal segments, proximal segments with 5 pairs. Cirrus IV to VI similar, longer than cirrus III; segments oblong, with 5 pairs of setae on anterior faces, distal 2 pairs longest. Cirral formula as follows:

Paratype:		C I	C II	C III	C IV	C V	C VI	c. a.
MNHN-	left	8, 6	8, 10	15, 18	17, 22	20, 22	21, 22	6
Ci 2396	right	13, 11	9, 9	14, 17	22, 23	24, 21	22, 23	7

Caudal appendages slightly longer than basal segment of pedicel of CVI, 6-7 segmented; sparse circlet of long setae terminally; long setae around distal segmental margins, setal length equal to or longer than segmental length. Penis subequal to length of cirrus VI; annulated; sparsely setose distally; circlet of long setae terminally. Eggs large, rounded, 0.40 x 0.42 mm.

Source : MNHN, Paris

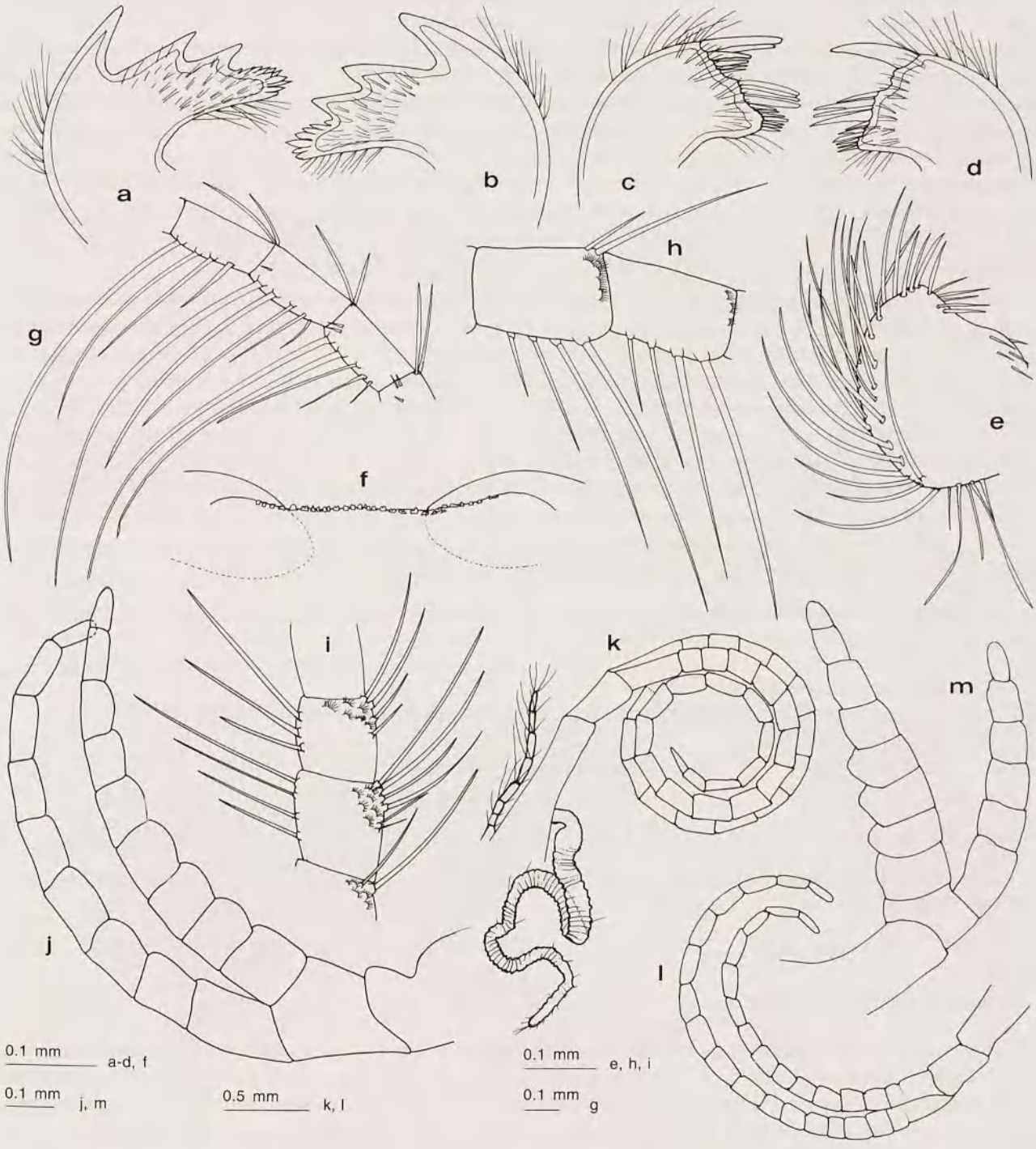

FIG. 18. — *Microlasma fragile* sp. nov. Paratype (ovigerous) from MUSORSTOM 6, stn DW 421 (MNHN-Ci 2396): **a**, right mandible; **b**, left mandible; **c**, right maxillule; **d**, left maxillule; **e**, maxilla; **f**, labrum; **g**, cirrus III, posterior ramus, median segments; **h**, cirrus II, posterior ramus, median segments; **i**, cirrus I, posterior ramus, median segments; **j**, cirrus II; **k**, cirrus VI, caudal appendage and penis; **l**, cirrus III; **m**, cirrus I.

REMARKS. — *Microlasma fragile* sp. nov. may be distinguished from other members of the genus by its fragile, thin, weakly articulated parietal plates. The size of *M. fragile* is similar to that of *M. arwetergum*

Source : MNHN, Paris

(maximum RC length 5.3, 5.0 respectively), but the overall upright shell form and circular basis, rather than a conical form with the basis elongated along the RC axis, distinguish the 2 species. The orifice of *M. arwetergum* is rhomboidal and not toothed rather than pentagonal and toothed as in *M. fragile*. Furthermore, in *M. arwetergum* CL^2 is smaller (CL^2 basal width 1/4 the basal width of CL^1 rather than 1/2 to 1/3 basal width of CL^1, and CL^2 shorter than CL^1 by 1/5 rather than equal to height of CL^1) and sharply tapering, with the apex so narrow that the apex of CL^1 almost touches C, rather than the height of CL^2 being equal to the height of CL^1 (*M. fragile*). The unique arrow-shaped T of *M. arwetergum* further separates the species. There are also differences in the soft parts between these two species — the maxillule of *M. arwetergum* is slightly notched, rather than broadly as in *M. fragile*, the upper margins of mandibular teeth 2 and 3 have small subsidiary cusps, rather than being smooth; and the caudal appendages (7-9 segmented) of *M. arwetergum* are slightly longer than the pedicel of cirrus VI, rather than slightly longer than the basal segment of the pedicel of cirrus VI (*M. fragile*).

Microlasma fragile is similar to *M. crinoidophilum* and *M. ochriderma* but differs from those species in size (maximum RC lengths 5.3, 9.0, 7.8, respectively) and in the form and size of CL^2 and T. In *M. fragile* the basal width of CL^2 is 1/2-1/3 the basal width of CL^1 and the height of CL^2 is equal to the height of CL^1. In *M. crinoidophilum* the basal width of CL^2 is 1/2 that of CL^1, and the apices of CL^2 taper abruptly, so that the alae of CL^1 almost touch the carinal alae; CL^2 is shorter than CL^1 by 1/5. In *M. ochriderma* the basal width of CL^2 is 2/3 that of CL^1, and CL^1 and CL^2 are equal in height. The T spur of *M. fragile* is 1/2 the height of the valve, its width is 1/5 that of the basal margin and it is set at 1/8 the length of the basal margin from the basi-scutal angle. The tergal spur of *M. ochriderma* is short, 1/2 the length of the basal margin and set at a distance of 1/10 the width of the basal margin from the basi-scutal angle. In *M. crinoidophilum* the short tergal spur is 1/3 the length of the basal margin and is set at a distance of 1/12 the length of basal margin from the basi-scutal angle. In none of these species is the tergal basal margin excised to produce an arrow-shape.

ETYMOLOGY. — From the Latin *fragilis*, "fragile", in reference to the fragile nature of the parietal plates and the opercular plates.

DISTRIBUTION. — Loyalty Islands, 245 m.

Microlasma ochriderma (Foster, 1981)

Fig. 15; Tables 7-8

Pachylasma ochriderma Foster, 1981: 354, fig. 5 A-J. — ROSELL, 1991: 37.

MATERIAL EXAMINED. — **Norfolk Island**. NZOI: stn P35, 28°57.9'S, 167°45.5'W, 392-423 m, 28.01.1977: holotype (NZOIH-356).

TYPES. — *Holotype*: NZOI H-356; Norfolk Island, NZOI stn P 35, 28°57.9'S, 167°45.5'W, 392-423 m, 28.01.1977.

Holotype depository: NIWA.

DIAGNOSIS. — Shell pale orange, externally smooth, internally with faint, irregular pegs along thickened basal edge of plates. Basal width of CL^2 2/3 basal width of CL^1; height of CL^2 equal to height of CL^1. Alae wide. S as wide as high, basal margin 2/3 length of occludent margin; articular ridge extending 1/2 length of tergal margin, projecting; growth ridges cut by few faint longitudinal striae. T spur short, width 1/2 length of basal margin, set at distance of 1/10 length of basal margin from basi-scutal angle; 5-7 muscle crests projecting from basal margin. Mandible with 3 sharp, curved teeth, margins smooth. Caudal appendages as long as basal segment of pedicel of cirrus VI, 7 segments.

REMARKS. — The species (RC length 7.8) is distinguished by the dimensions and the manner of articulation of the opercular plates, and by the orange color of the shell plates. Differences between *M. ochriderma* and *M. arwetergum* are listed under *M. arwetergum*, between *M. ochriderma* and *M. crinoidophilum* under *M. crinoidophilum*, and between *M. ochriderma* and *M. fragile* under *M. fragile*.

Source : MNHN, Paris

DISTRIBUTION. — Norfolk Island, 392-423 m.

Genus *PACHYLASMA* Darwin, 1854 (emend.)

Fig. 19; Tables 3-4, 9-11

Pachylasma Darwin, 1854: 475.

DIAGNOSIS. — Adult with fixed shell pattern of 6 parietal plates (R-CL^1-CL^2-C). Rostral plate compound, sutures obscure or visible (externally and internally or visible internally, inconspicuous externally), basal width of R equal to basal width of RL. CL^1 and CL^2 separate. Length of S basal margin 1/2 or more length of occludent margin; externally growth lines smooth or convoluted, often cut by numerous longitudinal striae. Caudal appendages varying from vestigial or reduced to 1/3 greater than length of pedicel of cirrus VI, from uniarticular to 19 segments.

TYPE SPECIES. — *Pachylasma giganteum* (Philippi, 1836).

RECENT SPECIES. — *Pachylasma bacum* sp. nov.; *P. darwinianum* Pilsbry, 1912; *P. ecaudatum* Hiro, 1939; *P. giganteum* (Philippi, 1836); *P. integrirostrum* Broch, 1931; *P. laeviscutum* sp. nov.; *P. ovatum* sp. nov.; *P. scutistriata* Broch, 1922.

DISTRIBUTION. — Mediterranean Sea; Indian Ocean to central Pacific Ocean: Mediterranean Sea, "deep water" (*P. giganteum*); Indian Ocean to New Zealand, Japan, South China Sea to Malaysia, 104-2050 m (*P. scutistriata*); Kei Is, Indonesia, 140 m (*P. integrirostrum* Broch, 1931); Japan, 200 m (*P. ecaudatum*); Philippines, 146 m (*P. darwinianum*); Vanuatu, Loyalty Islands, 182-270 m (*P. bacum*); New Caledonia, 300-616 m (*P. ovatum*); Vanuatu, New Caledonia, Norfolk Ridge, Futuna I., 140-466 m (*P. laeviscutum*).

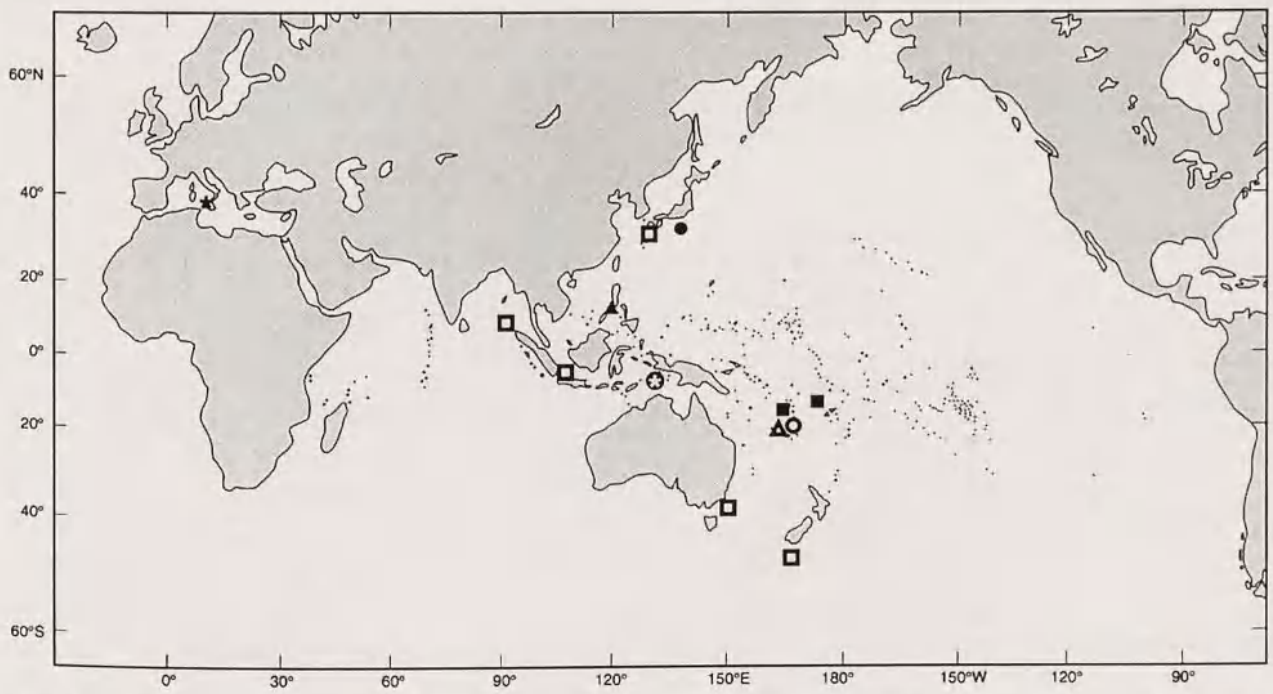

FIG. 19. — *PACHYLASMA* Darwin, 1854. Distribution map: ★, *P giganteum* ("deep water"); □, *P. scutistriata* (104-2050 m); ✪, *P. integrirostrum* (140 m); ●, *P. ecaudatum* (200 m); ▲, *P. darwinianum* (146 m); ❍, *P. bacum* (182-270 m); △, *P. ovatum* (300-616 m); ■, *P. laeviscutum* (140-466 m).

Source : MNHN, Paris

REMARKS. — In the present paper *Pachylasma* is considered a grouping whose resolution has yet to be determined. The affinities of the various species included under this genus are as yet unclear, but may be resolved as more material comes to hand. Differences between *Pachylasma, Eutomolasma, Microlasma, Eurylasma* and *Tetrapachylasma* are listed in tables 3 and 4. The species included herein are small (maximum: RC length 7.0, C height 2.5), moderate (maximum: RC length 10.5, C height 7.2), and large (maximum: RC length 30.0, C height 30.5) in size, and occur attached to gorgonians, sponges, bivalves, balanomorph barnacles, crinoids, antipatharians and coral rubble.

TABLE 9. — *Pachylasma*: characters of the species

	no. plates ext.	int.	R:RL	CL: CL²	T	basis
P. bacum sp. nov.	6	6	n.a.	separate; basal width CL² = basal width CL	artic. ridge barely proj.; spur short, 1/2 width basal margin, set 1/10 length basal margin from b-s angle; 11-15 muscle ridges extending well beyond basal margin	calcareous
P. darwinianum Pilsbry, 1912	6	8	R = RL	separate; basal width CL² ≥ 1/2 basal width CL	artic. ridge slightly proj.; spur absent; 8-10 muscle ridges extending well beyond basal margin; low rounded rib bounded by depressions on S 1/2	membranous
P. ecaudatum Hiro, 1939	6	6	n.a.	separate; basal width CL² = or slightly < than basal width CL	artic. ridge not proj.; spur indistinct, 3/8 width basal margin, set 1/8 length basal margin from b-s angle; 8-11 muscle ridges extending well beyond basal margin; slight ridge parallel to S margin where growth lines angularly upturned	calcareous edges; membranous centrally
P. giganteum (Philippi, 1836)	6	6	n.a.	separate; basal width CL² = basal width CL	artic. ridge slightly proj.; spur short, indistinct, 1/2 width basal margin, set 1/7 length basal margin from b-s angle; 8-10 muscle ridges extending well beyond basal margin; growth lines angularly upturned close along S margin	calcareous
P. integrirostrum Broch, 1931	6	6	n.a.	basal width CL² = 1/2 basal width CL	artic. ridge proj.; spur indistinct, 1/2 width basal margin, set 1/9 length basal margin from b-s angle; 4-6 muscle ridges not extending beyond basal margin; S side of spur with shallow groove	edges strongly calcareous;, membranous centrally
P. laeviscutum sp. nov.	6	8	R = RL	separate; basal width CL² = basal width CL	artic. ridge proj.; spur short, indistinct, >1/3 width basal margin, set 1/9 length basal margin from b-s angle; 13-18 muscle ridges slightly extending beyond basal margin; growth lines angularly upturned close along S margin	calcareous edges, membranous centrally
P. ovatum sp. nov.	6	8	R = RL	separate; basal width CL² = 7/8 basal width CL	artic. ridge proj.; spur short, 2/5 width basal margin, set < 1/5 length basal margin from b-s angle; 12-14 muscle ridges extending well beyond basal margin	calcareous edges, membranous centrally
P. scutistriata Broch, 1922	6	8	R = RL	separate; basal width CL² = basal width CL	artic. ridge proj.; spur indistinct, 1/3 width basal margin; not separated from b-s angle; muscle ridges not extending beyond basal margin	calcareous edges, membranous centrally (adults); membranous (juveniles)

artic. = articular; b-s = basi-scutal; ext. = external; int. = internal; max. = maximum; n.a. = not applicable; proj. = projecting.

Source : MNHN, Paris

TABLE 10. — *Pachylasma*: characters of the species (continued)

	S shape	S growth lines	caudal appendage	mandible
P. bacum sp. nov.	S basal margin = 7/12 length of S occludent margin; artic. ridge slightly proj.	extremely convoluted; cut by 10-14 long. striae, giving 'beaded' appearance	uniarticulate; extremely reduced, leaf-like	tridentate; upper margins of tooth 3 or upper margins of 2 and 3 often with small subsidiary cusps
P. darwinianum Pilsbry, 1912	S width = 1/2 S length; artic. ridge barely proj.	strongly convoluted; not cut by long. striae	uniarticulate; extremely reduced, represented by swollen mounds with minute bristles	tridentate; upper margins of teeth 1 and/or 2 often with small subsidiary cusps
P. ecaudatum Hiro, 1939	S basal margin = 5/9 length of S occludent margin; artic. ridge not proj.	convoluted; cut by 8 long. striae	uniarticulate; extremely reduced, represented by swollen mounds with few minute bristles	tridentate; upper margins of teeth 2 and 3 with small subsidiary cusps
P. giganteum (Philippi, 1836)	S basal margin 3/5 length of S occludent margin; artic. ridge not proj.	sinuous; cut by 4-6, faint long. striae	19 segs; 1/3 > than height of pedicel of CVI	tridentate; upper margins of teeth smooth
P. integrirostrum Broch, 1931	S basal margin = 1/2 length of S occludent margin; artic. ridge slightly proj.	not convoluted, feeble; not cut by long. striae	6 segs; = height of basal segment of pedicel of CVI	tridentate; tooth 1 well separated from 2 and 3; upper margins of tooth 2 with small subsidiary cusps
P. laeviscutum sp. nov.	S basal margin = 1/2 length of S occludent margin; artic. ridge slightly proj.	slightly sinuous; cut by traces of 2-3 faint long. striae	8-9 segs; = height of basal segment of pedicel of CVI	tridentate; upper margins of teeth 2 and 3 with small subsidiary cusps
P. ovatum sp. nov.	S basal margin = >1/2 length of S occludent margin; artic. ridge proj.	moderately convoluted; cut by 12-15 long. striae	absent	tridentate; upper margins of teeth 2 and 3 with small subsidiary cusps
P. scutistriata Broch, 1922	S basal margin = >1/2 length of S occludent margin; artic. ridge slightly proj.	convoluted; cut by many long. striae	15-18 segs; slightly longer than pedicel of CVI	tridentate; upper margins of teeth 2 and 3 with small subsidiary cusps

artic. = articular; long. = longitudinal; max. = maximum; proj. = projecting; segs = segments.

TABLE 11. — *Pachylasma*: maximum size, geographical and bathymetrical distribution of the species

	size (max.)	distribution	depth
P. bacum sp. nov.	RC length 14.0 C height 7.0	Loyalty Is, Vanuatu	270 m 182-215 m
P. darwinianum Pilsbry, 1912	basal diameter 18.0-20.5	Philippines	146 m
P. ecaudatum Hiro, 1939	RC length 10.0 C height 6.0	Japan	200 m
P. giganteum (Philippi, 1836)	basal diameter 30.0 C height 30.5	Mediterranean Sea	'deep'
P. integrirostrum Broch, 1931	RC length 7.0 C height 2.5	Kei Is, Indonesia	140 m
P. laeviscutum sp. nov.	RC length 10.5 C height 7.2	Vanuatu, New Caledonia, Norfolk Ridge, Futuna I.	140-466 m 135-420 m 260-350 m 244-440 m
P. ovatum sp. nov.	RC length 14.6 C height 10.7	New Caledonia	300-616 m
P. scutistriata Broch, 1922	RC length 20.0 C height 15.0	Indian Ocean, Japan, S China Sea, Malaysia, Tasmania, Bass Strait New Zealand	104-293 m

Source : MNHN, Paris

Pachylasma bacum sp. nov.

Figs 19-22; Tables 9-11

MATERIAL EXAMINED. — **Loyalty Islands**. MUSORSTOM 6: stn CP 401, 270 m: 1 specimen, attached to sponge (MNHN-Ci 2503). Drawn.

Vanuatu. MUSORSTOM 8: stn CP 1086, 182-215 m: 1 specimen (MNHN-Ci 2397).

TYPES. — *Holotype*: MNHN-Ci 2397 (MUSORSTOM 8, stn CP 1086).

Paratype: MNHN-Ci 2503 (MUSORSTOM 6, stn CP 401). Drawn.

DIAGNOSIS. — Rostral plate broad, sutures obscure. Basal width of CL^1 equal to basal width of CL^2. S with externally convoluted growth ridges cut by 10-14 radial striations; articular ridge slightly projecting. T spur short, almost indistinguishable from basal margin; 11-15 muscle attachment ridges extending well beyond basal margin; articular ridge barely projecting. Caudal appendages reduced, leaf-like.

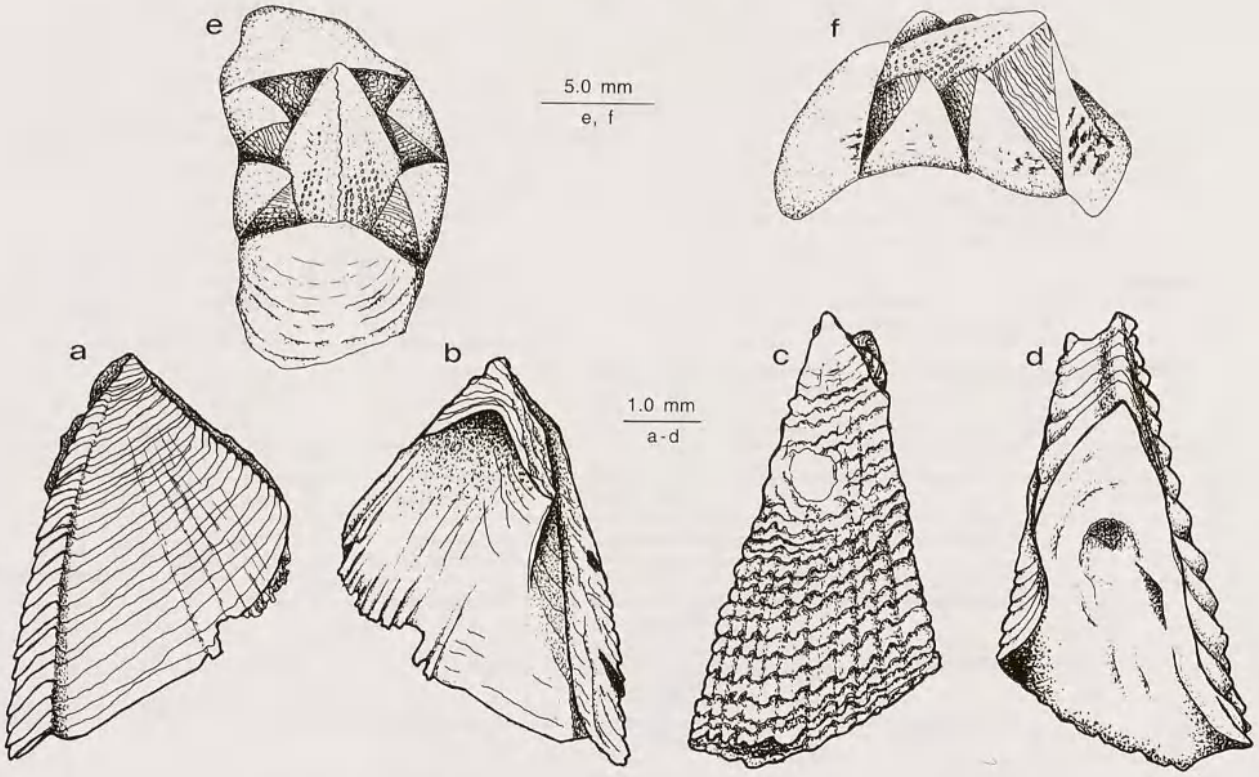

FIG. 20. — *Pachylasma bacum* sp. nov. Paratype from MUSORSTOM 6, stn CP 401 (MNHN-Ci 2503): **a**, T, external view; **b**, T, internal view; **c**, S, external view; **d**, S, internal view; **e**, whole animal, from above; **f**, whole animal, lateral view.

DESCRIPTION. — Shell large (maximum: RC length 14.0, C height 7.0); form circular. Parietal plates with irregular growth ridges not well-defined, except on rostral plate. Rostral plate slightly broader than C, sutures obscure. Basal width of CL^1 equal to basal width of CL^2, 1/2 to 1/3 basal width of rostral plate. C wider than CL^1 and CL^2, narrower than rostral plate, height equal to or greater than rostral plate; plate sloping toward orifice; apex acute. Alae wide, triangular; growth ridges well-developed, parallel to inferior alar margin; superior alar margins oblique, not serrate; alae of C widest, alae of CL^1 and CL^2 equal in size, 1/2 width of carinal alae. Basis calcareous. Orifice small, pentagonal, slightly toothed; apex of rostral plate curving in toward orifice, apices of

Source : MNHN, Paris

CL^1 and CL^2 sloping toward C. Opercular plates set at angle of approximately 20° to basis. S triangular, apex acute, basal margin convex, 7/12 length of occludent margin; externally growth ridges extremely convoluted, cut by 10-14 radial striations, giving 'beaded' appearance; internally with adductor muscle pit approximately medial; lateral depressor muscle pit indistinct; articular furrow narrow; articular ridge extending 1/2 length of valve, projecting slightly beyond articular margin; adductor ridge indistinct. T larger than S, triangular; as wide as high; externally with prominent, regular growth ridges, few radial striations in carinal area; internally with 11-15 strong muscle attachment ridges extending beyond basal margin; articular ridge barely projecting beyond articular margin; articular furrow broad; spur short, almost indistinguishable from basal margin, 1/2 width of basal margin, set at distance of 1/10 length of basal margin from basi-scutal angle. Color of parietal plates orange-yellow with rusty orange markings; alae creamy yellow, those of C, CL^1 and CL^2 with rusty orange markings. Measurements of 2 specimens as follows:

	RC length	LD	C height	R height
Holotype: MNHN-Ci 2397	10.6	9.8	7.0	3.6
Paratype: MNHN-Ci 2503	14.0	8.7	6.0	6.3

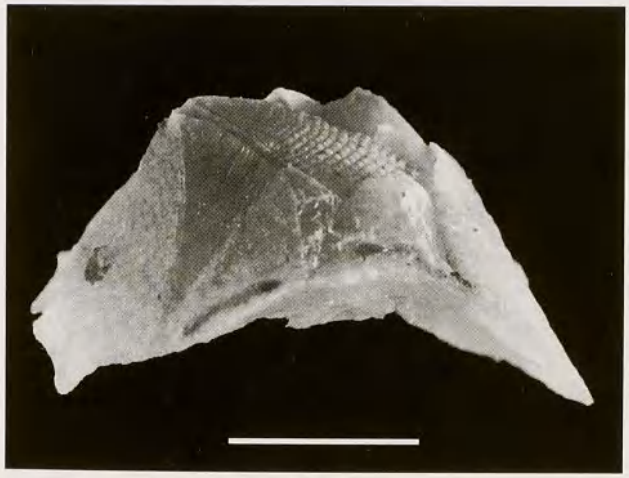

FIG. 21. — *Pachylasma bacum* sp. nov. Paratype from MUSORSTOM 6, stn CP 401 (MNHN-Ci 2503): lateral view. Scale = 5 mm.

Labrum with shallow medial depression, small teeth absent. Mandibular palp broadly ovate; dense, serrate setae terminally. Mandible with 3 teeth, tooth 1 largest, separated from teeth 2 and 3; upper margins of 3 or upper margins of 2 and 3 often with small subsidiary cusps, 2 sometimes with subsidiary, smaller tooth distally; inferior angle large, bluntly molariform, dentate. Maxillule with pair of long, stout setae at upper angle; notch below upper angle wide (right maxillule of illustrated specimen with notch barely defined), with 3-5 pairs of smaller setae; straight cutting margin below with 6-8 pairs of larger setae; inferior angle protuberant, with 5-6 pairs of smaller setae. Maxilla wide, coxal endite well developed; long serrulate setae terminally.

Cirrus I with rami subequal; anterior ramus slightly longer than posterior; proximal segments of anterior ramus anteriorly protuberant; both rami with segments thickly setose. Cirrus II longer than cirrus I; rami subequal, anterior ramus shorter than posterior; proximal segments of anterior ramus anteriorly protuberant; posterior ramus distally antenniform, small spines along distal margins of segments; all segments setose, setae simple or serrulate, especially distally. Cirrus III longer than cirrus II, with rami subequal, segments becoming oblong distally; posterior ramus with 3-5 pairs of long, finely serrulate setae on anterior faces of distal segments; anterior ramus with 3-5 pairs of long, finely serrulate setae on anterior faces of more distal segments, proximal segments with 8 pairs. Cirrus IV to VI similar, longer than cirrus III; segments oblong, with 4-5 pairs of setae on anterior faces, distal 2 pairs longest, finely serrulate. Chaetotaxy ctenopod. Cirral formula as follows:

Paratype:		C I	C II	C III	C IV	C V	C VI	c. a.
MNHN-	left	10, 9	12, 16	21, 20	23, 23	25, 24	25, 25	reduced
Ci 2503	right	10, 9	13, 17	21, 19	22, 23	24, 24	24, 25	reduced

Caudal appendages reduced, leaf-like, with small, stout setae apically. Penis equal to length of basal segment of pedicel of cirrus VI; sparsely setose, with circlet of short setae distally.

Source : MNHN, Paris

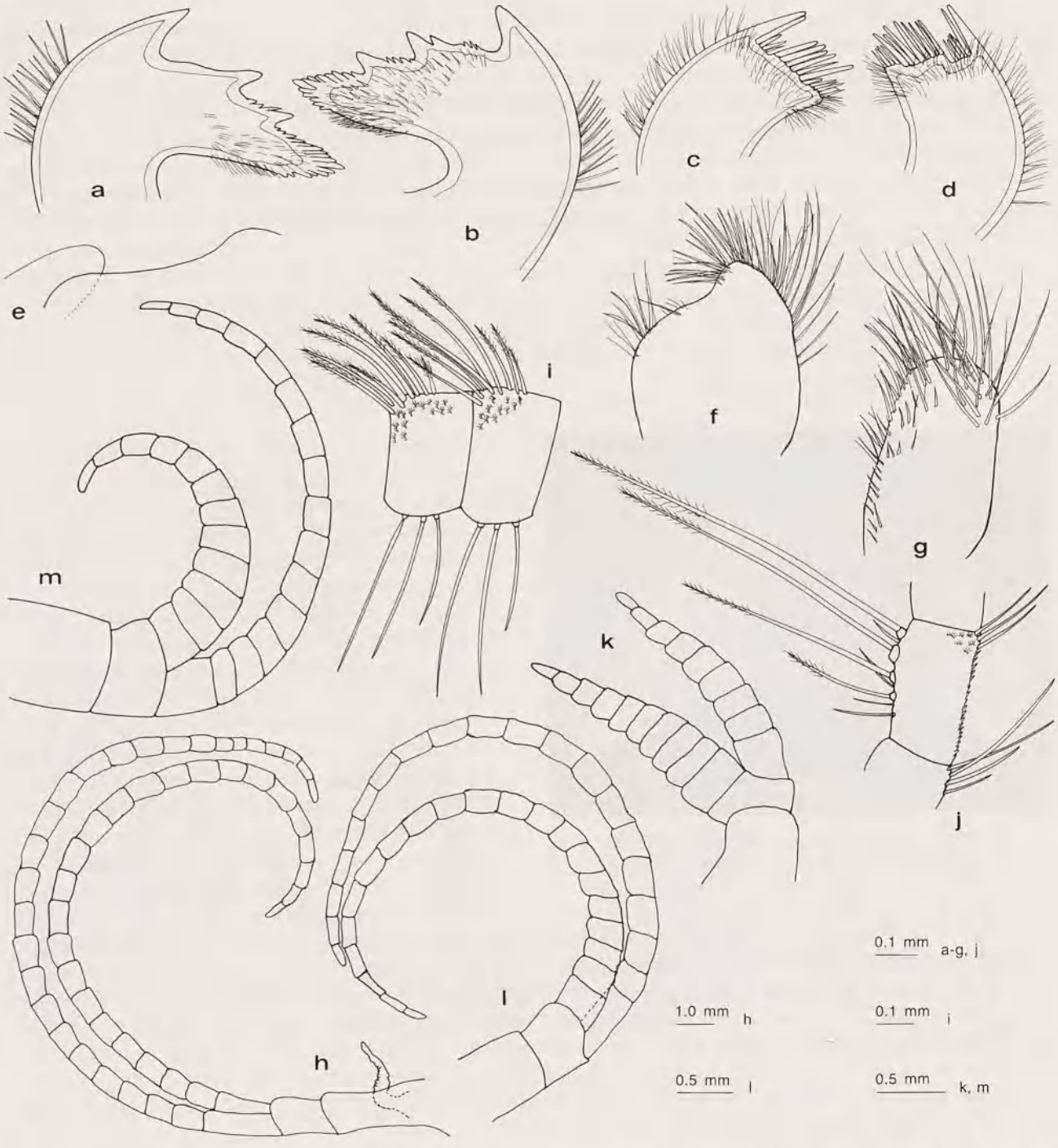

FIG. 22. — *Pachylasma bacum* sp. nov. Paratype from MUSORSTOM 6, stn CP 401 (MNHN-Ci 2503): **a**, right mandible; **b**, left mandible; **c**, right maxillule; **d**, left maxillule; **e**, labrum; **f**, left maxilla; **g**, mandibular palp; **h**, cirrus VI and penis; **i**, cirrus I, posterior ramus, median segments; **j**, cirrus II, posterior ramus, median segments; **k**, cirrus I; **l**, cirrus III; **m**, cirrus II.

REMARKS. — The circular form of the specimen from the Loyalty Islands is modified to an elongated oval, due to its attachment position on the host sponge. *Pachylasma bacum* sp. nov. is similar to *P. ovatum* sp. nov., but the 2 may be separated by the presence or absence of rostral plate sutures, visible in *P. ovatum*, obscure in

Source : MNHN, Paris

P. bacum. There are also differences in the relative sizes of the parietal plates - in *P. bacum* the basal width of CL^1 is equal to the basal width of CL^2 and 1/2 to 1/3 the width of the rostral plate; in *P. ovatum* the basal width of CL^2 is 7/8 the basal width of CL^1 and is equal to the basal width of the rostral plate. The basis is calcareous in *P. bacum* but is membranous with calcareous edges in *P. ovatum*. In *P. bacum* the S articular ridge is 1/2 the length of the valve and slightly projects beyond the articular margin; in *P. ovatum* it is 3/4 the length of the valve and projects beyond the articular margin. The tergal articular ridge of *P. bacum* barely projects beyond the articular margin; in *P. ovatum* it is short, well-developed and prominent, projecting beyond the articular margin. The caudal appendages are reduced and leaf-like in *P. bacum*, and absent in *P. ovatum*. The color of *P. bacum* is orange-yellow with rusty orange markings; *P. ovatum* is a dirty creamy white color.

The new species is similar to *P. ecaudatum* Hiro, 1939, but there are the following differences: the caudal appendages are reduced and leaf-like, with small, stout setae apically in *P. bacum* and absent in *P. ecaudatum*; the basis is entirely calcareous in *P. bacum* rather than calcareous, thin and centrally membranous (*P. ecaudatum*); cirral counts for cirri III-VI are greater in *P. bacum* (CIII 21/19, CIV 22/23, CV 24/24, CVI 24/25) than in *P. ecaudatum* (CIII 16/16, CIV 17/17, CV 18/18, CVI 20/20) and the colour of *P. bacum* is orange-yellow with rusty orange markings, whereas in *P. ecaudatum* the parietal plates are whitish, mottled with pink reticulations and the alae are uniformly rosy. *Pachylasma bacum* is larger in size (RC diameter 14.0, C height 7.0) and found attached to sponges, whilst *Pachylasma ecaudatum* (RC diameter 10.0, C height 6.0) has been found attached to the bivalve *Malleus regulus* (Forskål, 1775).

ETYMOLOGY. — From the Latin *bacum*, "bead", in reference to the beaded appearance of the scuta.

DISTRIBUTION. — Loyalty Islands, 270 m; Vanuatu, 182-215 m.

Pachylasma darwinianum Pilsbry, 1912

Fig. 19; Tables 9-11

Pachylasma darwinianum Pilsbry, 1912: 293; 1916: 329. — NEWMAN & ROSS, 1976: 40. — ROSELL, 1991: 37.

MATERIAL EXAMINED. — **Philippines**. *"Albatross"*: stn 5168, Sulu Arch., Tawi Tawi Group, 4°56'30"N, 119°45'40"E, 146 m, 25.02.1908: holotype (USNM 43465).

TYPES. — *Holotype*: USNM 43465; Philippines, *"Albatross"*, stn 5168, Tawi Tawi Group, Sulu Arch., 146 m; dry (1 lot) and slides (3).
Holotype depository: USNM.

DIAGNOSIS. — Rostral plate with sutures visible internally but not externally. Basal width of CL^2 more than 1/2 basal width of CL^1. S growth ridges strongly convoluted, not cut by longitudinal striae; articular ridge barely projecting. T spur absent, 8-10 muscle crests projecting beyond basal margin; articular ridge slightly projecting. Mandible with upper margins of teeth 1 and/or 2 often with small subsidiary cusps. Caudal appendages uniarticulate, represented by swollen mounds with few, minute bristles.

REMARKS. — *Pachylasma darwinianum* is a large species (maximum RC length 20.5). It is most similar to *P. bacum* sp. nov. and *P. ecaudatum*, as all have extremely reduced caudal appendages which are uniarticulate. In *P. darwinianum* and *P. ecaudatum* the caudal appendages are represented by swollen mounds with a few, minute bristles apically; in *P. bacum* they are leaf-like, with small, stout setae apically. In *P. darwinianum* the basal width of CL^1 is greater than 1/2 the basal width of CL^2, in *P. bacum* it is equal to the basal width of CL^2, in *P. ecaudatum* it is equal to or slightly less than the basal width of CL^2. The basis of *P. darwinianum* is membranous, that of *P. bacum* is calcareous and that of *P. ecaudatum* is membranous centrally, with calcareous edges. The T spur is absent in *P. darwinianum* and there are 8-10 muscle attachment ridges projecting well beyond the basal margin; in *P. bacum* the spur is short, 1/2 the width of the basal margin and set at 1/10 the length of the basal margin from the basi-scutal angle, and there are 11-15 muscle attachment ridges projecting well beyond

Source : MNHN, Paris

the basal margin; in *P. ecaudatum* it is indistinct, 3/8 the width of the basal margin and set at 1/8 the length of the basal margin from the basi-scutal angle, and there are 8-11 muscle attachment ridges projecting well beyond the basal margin. The dull red to whitish color of the parietal plates further distinguish *P. darwinianum* from all others in the genus.

DISTRIBUTION. — Tawi Tawi Group, Sulu Archipelago, Philippines, 146 m.

Pachylasma ecaudatum Hiro, 1939

Fig. 19; Tables 9-11

Pachylasma ecaudatum Hiro, 1939: 52, figs 3-4. — NEWMAN & ROSS, 1976: 40.
Hexelasma ecaudatum - UTINOMI, 1968: 31, fig. 6.

TYPES. — *Holotype*: SMBL Type 30; Japan, Ogasawara I., 200 m, associated with bivalves (*Malleus regulus* Forskål, 1775).
Holotype depository: SMLB (specimen has not been located).

DIAGNOSIS. — Rostral plate lowest of all plates, sutures obscure. Basal width of CL^2 equal to or narrower than basal width of CL^1. S externally with convoluted growth ridges cut by 8 longitudinal striae; articular ridge not projecting. T articular ridge not projecting; externally with growth ridges prominent, spur indistinct, 3/8 width of basal margin; 8-11 muscle attachment ridges extending well beyond basal margin. Caudal appendages uniarticulate, represented by few minute bristles on swollen mounds.

REMARKS. — *Pachylasma ecaudatum* is a moderate sized species (maximum: RC length 10.0, C height 6.0). The thin calcareous basis which is centrally membranous, the form of the T, the reduction of the caudal appendages and the whitish parietal plates, mottled with pink reticulations, determine this species. *Pachylasma ecaudatum* is most similar to *P. bacum* sp. nov.; differences between these 2 species are listed under *P. bacum.*

DISTRIBUTION. — Ogasawara Is, Japan, 200 m.

Pachylasma giganteum (Philippi, 1836)

Fig. 19; Tables 9-11

Chthamalus giganteus Philippi, 1836: 250.
Pachylasma giganteum - DARWIN, 1854: 477, pl. 19 figs 5 a-d. — WELTNER, 1897: 273. — GRUVEL, 1905: 198, fig. 218. — PILSBRY, 1916: 329. — KOLOSVÁRY, 1942: 143; 1943: 77; 1952: 412. — WITHERS, 1953: 60. — RELINI, 1969: 169. — STUBBINGS, 1967: 263. — NEWMAN & ROSS, 1976: 40.

TYPES. — *Holotype*: BMNH Cat. No. 12060 Seguenza, in Jeffreys collection; Strait of Messina.
Holotype depository: BMNH. [specimen has not been located in the collections of the BMNH (Ms A. MORGAN, pers. Comm. 05.02.1996)].

DIAGNOSIS. — Rostral plate sutures obscure. CL^1 and CL^2 equal sized. S with prominent, sinuous growth ridges cut by 4-6, longitudinal striae; articular ridge not projecting. T with growth ridges prominent; spur short, 1/2 width of basal margin; 8-10 muscle attachment ridges projecting well beyond basal. Caudal appendages 1/3 longer than pedicel of cirrus VI, 19 segments.

REMARKS. — This species (maximum: RC length 30.0, C height 30.5) is distinguished from all others in the genus by its large size, by the dirty white color of the parietal plates and the form of the opercular plates. *Pachylasma giganteum* is similar to *P. bacum* as both species have a calcareous basis; the basis of *P. giganteum* is of variable thickness. Differences between *P. giganteum* and *P. bacum* are listed under *P. bacum.*

DISTRIBUTION. — Sicily, Mediterranean Sea; "deep water" (DARWIN, 1854).

Source : MNHN, Paris

Pachylasma integrirostrum Broch, 1931

Fig. 19; Tables 9-11

Pachylasma integrirostrum Broch, 1931: 50, fig. 18. — Newman & Ross, 1976: 40.

Material examined. — **Indonesia**. Danish Exped. to Kei Is 1922: Mollucas, Amboina Bay, 140 m, 22.02.1922: syntypes (ZMC Cru 1977).

Types. — *Syntypes*: ZMC Cru 1977; Indonesia, Mortensen's Pacific Exped. 1914-16, Kei Islands, Amboina Bay, 140 m, 22.02.1922; 4 specimens.

Syntypes Location: ZMC.

Diagnosis. — Parietal plates covered by persistent yellowish/brownish epidermis. Rostral plate sutures obscure. Basal width of CL^2 almost 1/2 basal width of CL^1. S growth ridges feeble, radial striations absent; articular ridge slightly projecting. T with growth ridges feeble, smooth, not cut by longitudinal striae; spur indistinct, 1/2 width of basal margin; 4-6 weak muscle crests not extending beyond basal margin; S side of spur marked by shallow groove; articular ridge projecting. Caudal appendages equal to height of basal segment of pedicel of cirrus VI; 6 segments.

Remarks. — In his description of *Pachylasma integrirostrum* from Ambon, Broch (1931: 50) referred to the development of the alae of CL^2 (determined as CL by Broch) as "....subject to variations: in three specimens - among them also in the type specimen (fig. 18a) they are externally visible only in the uppermost part of the plate, but in the fourth they are almost as conspicuous as those of the lateral plates". After examining the 4 specimens of *P. integrirostrum* described by Broch, the alae of CL^2 of the 3 intact specimens are conspicuous, especially when the small size of the specimens is taken into account. The alae of CL^2 are approximately 1/2 the width of the alae of CL^1, and extend most of the height of the shell. The fourth specimen, labelled 'type', is disarticulated, but was illustrated whole by Broch prior to disarticulation. Broch illustrated a small CL^2 ala (Broch, 1931, fig. 18a). By inference from Broch's written description, similar small-sized CL^2 alae should also be found in 2 of the 3 remaining whole specimens. However, in these 3 intact specimens I regard the CL^2 alae as conspicuous.

This small species (maximum: RC length 7.0, C height 2.5) differs from all others presently included in *Pachylasma* by 2 features; the basal width of CL^2 is almost 1/2 the basal width of CL^1, rather than equal or subequal, as in the other species within *Pachylasma*; and the S external growth lines are feeble, not sinuous or convoluted, and not cut by longitudinal striae. In the remaining species within *Pachylasma* the S external growth lines are sinuous or convoluted, and cut by longitudinal striae, which may be faint in some species (e.g. *P. laeviscutum* sp. nov.).

Pachylasma integrirostrum is similar to *P. bacum, P. ecaudatum,* and *P. giganteum* as they all have a discrete, rather than tripartite, rostral plate. However, the basis of *P. bacum* and of *P. giganteum* is calcareous, rather than calcareous at the edges and membranous centrally, as in *P. integrirostrum* and *P. ecaudatum.* The S external growth lines of *P. ecaudatum* are convoluted and cut by 8 longitudinal striae; those of *P. integrirostrum* are feeble, not sinuous or convoluted, and not cut by longitudinal striae. These latter 2 species can be further separated by the caudal appendages - uniarticulate and extremely reduced being represented by swollen mounds with a few minute bristles in *P. ecaudatum*, 6-segmented and the height of the basal segment of the pedicel of cirrus VI in *P. integrirostrum.*

Distribution. — Ambon, Mollucas, Indonesia; 140 m.

Pachylasma laeviscutum sp. nov.

Figs 19, 23-25; Tables 9-11

Material examined. — **Norfolk Ridge**. Smib 5: stn DW 85, 260 m: 1 specimen (broken and lacking R). — Stn DW 88, 350 m: 1 specimen (dry), attached to gorgonian.

Source : MNHN, Paris

New Caledonia. MUSORSTOM 4: stn CP 190, 215 m: 1 specimen (shell only), attached to stem of dead gorgonian. — Stn DW 230, 390-420 m: 3 specimens, attached to stem of dead gorgonian (MNHN-Ci 2399).

Vanuatu. MUSORSTOM 8: stn DW 962, 370-400 m: several specimens, attached to gorgonian (WAM C 23249). — Stn CP 963, 400-440 m: 1 specimen. — Stn DW 988, 372-466 m: several specimens, attached to gorgonian. — Stn DW 1131, 140-175 m: several specimens, attached to gorgonian.

Futuna Island. MUSORSTOM 7: stn CP 508, 245-440 m: 3 specimens, attached to stem of dead gorgonian (MNHN-Ci 2697). — Stn CP 515, 224-252 m: 2 specimens, attached to stem of gorgonian (MNHN-Ci 2398, WAM 253-96). Drawn.

TYPES. — *Holotype*: MNHN-Ci 2398 (MUSORSTOM 7, stn CP 515).

Paratypes: MNHN-Ci 2399 (MUSORSTOM 4, stn DW 230). — MNHN-Ci 2697 (MUSORSTOM 7, stn CP 508). — WAM 253-96 (MUSORSTOM 7, stn CP 515). Drawn.

DIAGNOSIS. — Rostral plate with basal width R equal to basal width of RL. Basal width of CL^1 subequal to basal width of CL^2. S externally with growth ridges slightly sinuous, cut by traces of 2-3 slight radial striations; S articular ridge slightly projecting. T spur indistinct, more than 1/3 length of basal margin; 13-18 muscle attachment ridges extending slightly beyond basal margin; articular ridge projecting. Caudal appendages equal to height of basal segment of pedicel of cirrus VI, 8-9 segments.

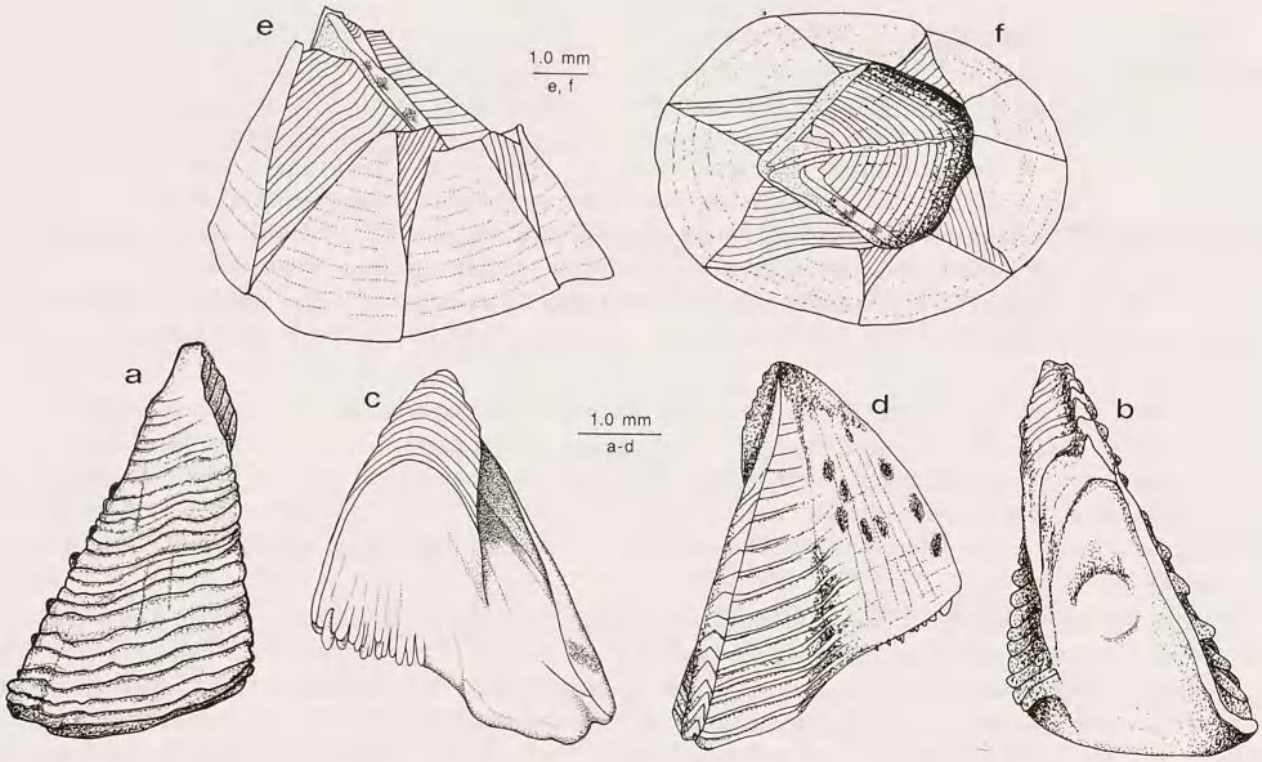

FIG. 23. — *Pachylasma laeviscutum* sp. nov. Paratype from MUSORSTOM 7, stn CP 508 (MNHN-Ci 2697): **a**, S, external view; **b**, S, internal view; **c**, T, internal view; **d**, T, external view; **e**, whole animal, lateral view; **f**, whole animal, from above.

DESCRIPTION. — Size moderate (maximum: RC length 10.5, C height 7.2). Shell form upright, parietal plates gently sloping toward orifice. Parietal plates smooth, growth ridges regular, faint, not marked by setae, in larger specimens paries more rugged, growth ridges less regular. Tripartite rostral plate convex, basal width twice basal width of C; rostral sutures visible externally and internally, basal width of R equal to basal width of RL. CL^1 and CL^2 separate, basal width of CL^1 subequal to basal width of CL^2. C higher than rostral plate, basal width 1/2 basal width of rostral plate. Alae wide, those of C widest, alae of CL^1 1/2 width of C alae, alae of CL^2 1/4 width

Source : MNHN, Paris

of C alae; growth ridges parallel to inferior alar margins, well-marked, summits oblique. Orifice large, pentagonal, not toothed. Basis thin, calcareous at edges, membranous centrally; flat. Opercular plates sloping at angle of approximately 45° to basis. S subequal to T; elongated triangle, basal margin 1/2 length occludent margin; externally growth ridges slightly sinuous, not fluted, cut by traces of 2-3 slight radial striations; internally adductor muscle pit situated at 1/2 length of valve; lateral depressor muscle pit indistinct; articular furrow narrow; articular ridge extending 2/3 length of valve, projecting slightly beyond articular margin; adductor ridge indistinct. T subtriangular; width equal to height; externally growth ridges prominent, angularly upturned close along scutal margin, longitudinal striations in carinal area over depressor muscle region; internally with 13-18 small muscle crests projecting beyond basal margin; articular ridge long, slightly extending beyond articular margin; articular furrow broad, shallow; spur short, truncate, width more than 1/3 length of basal margin, set at distance of 1/9 length of basal margin from basi-scutal angle. Color of parietal plates orange with some rusty-red markings. Measurements of 10 specimens examined as follows:

	RC length	LD	C height	R height
rg	4.9-10.5	3.8-7.6	2.6-7.2	1.6-6.0
$\bar{x}$	8.0	5.8	4.9	3.8

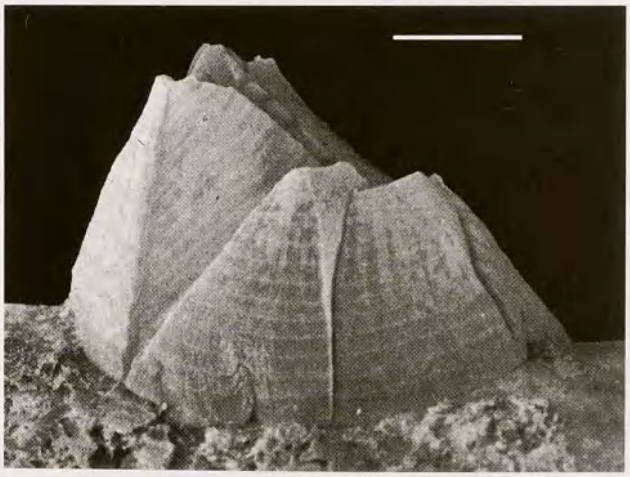

FIG. 24. — *Pachylasma laeviscutum* sp. nov. Holotype from MUSORSTOM 7, stn CP 515 (MNHN-Ci 2397): lateral view. Scale = 1 cm.

Labrum with shallow medial depression; teeth absent but irregular groups of minute denticles present. Mandibular palp ovate, elongated; long serrate setae terminally. Mandible with 3 primary teeth, tooth 1 largest, well separated from 2 and 3; upper margins of 2 and 3 with small subsidiary cusps; inferior angle large, bluntly molariform, dentate. Maxillule setose; 3 long setae at upper angle; indistinct notch below with 2-3 pairs of smaller setae; cutting margin below notch slightly stepped, with 7-8 pairs of longer setae; inferior angle slightly stepped, with 4-7 pairs of smaller setae. Maxilla wide, with dense, long setae; coxal endite more developed than basal endite.

Cirrus I with rami unequal; anterior ramus longer than posterior; proximal segments of anterior ramus protuberant anteriorly; both rami with segments thickly setose. Cirrus II longer than cirrus I, similar to cirrus III; rami subequal; proximal segments of anterior ramus broad, slightly protuberant anteriorly, all segments thickly setose; posterior ramus antenniform, segments elongated, narrow, distal segments with 2-3 long setae antero-distally. Cirrus III more similar to cirri IV-VI than to cirri I and II; rami subequal, segments becoming oblong distally, more distal segments of both rami with 4 pairs of long setae on anterior faces. Cirrus IV to VI similar, longer than cirrus III; segments oblong, with 4 pairs of setae on anterior faces, distal 2 pairs of setae longest. Chaetotaxy ctenopod. Cirral formula as follows:

Paratype:		C I	C II	C III	C IV	C V	C VI	c. a.
WAM	left	12, 10	14, 11	18, 18	21, 23	24, 21	25, 24	9
253-96	right	13, 11	14, 12	20, 21	22, 23	24, 21	25, 26	8

Caudal appendages length of proximal segment of pedicel of cirrus VI; 8-9 segmented; long setae terminally and around distal segmental margins. Penis more than 1/2 length of cirrus VI; finely annulated; sparsely setose, with dense rosette of moderately long, fine setae distally.

Source : MNHN, Paris

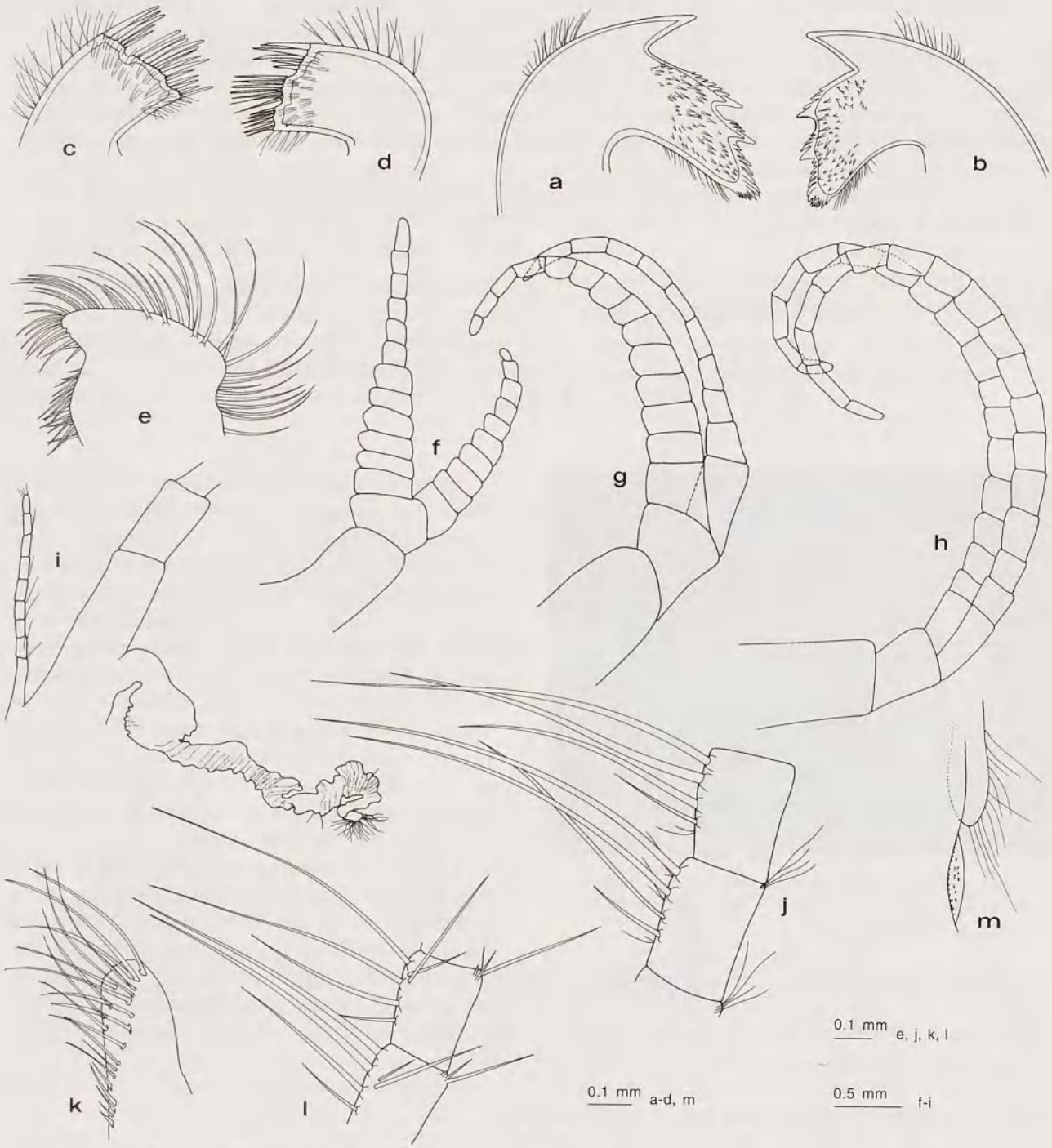

FIG. 25. — *Pachylasma laeviscutum* sp. nov. Paratype from MUSORSTOM 7, stn CP 508 (MNHN-Ci 2697): **a**, right mandible; **b**, left mandible; **c**, right maxillule; **d**, left maxillule; **e**, maxilla; **f**, cirrus I; **g**, cirrus II; **h**, cirrus III; **i**, pedicel of cirrus VI, caudal appendage and penis; **j**, cirrus VI, posterior ramus, median segments; **k**, mandibular palp; **l**, cirrus III, posterior ramus, median segments; **m**, labrum.

REMARKS. — *Pachylasma laeviscutum* sp. nov., *P. ovatum* sp. nov. and *P. scutistriata* are similar because all have the rostral sutures visible externally. However, there are differences in the form and length of the caudal appendages, which are 8-9 segmented and the length of the basal segment of the pedicel of cirrus VI in

Source : MNHN, Paris

P. laeviscutum; absent in *P. ovatum;* and 15-18 segmented and a little longer than the pedicel of cirrus VI in *P. scutistriata*. There are also differences in the ornamentation of the S - the scutal growth ridges are slightly sinuous and cut by 2-3 slight radial striations in *P. laeviscutum*; moderately convoluted and cut by 12-15 radial striations in *P. ovatum*; and convoluted and distinctly divided by many radial striations in *P. scutistriata*. Features of the T also separate these species. In *P. laeviscutum* the indistinct tergal spur is more than 1/3 the width of the basal margin, set at distance of 1/9 the length of the basal margin from the basi-scutal angle, 13-18 muscle attachment crests slightly extend from the basal margin, and the articular ridge slightly projects beyond the articular margin. In *P. ovatum* the short spur is more than 2/5 the width of the basal margin, set at distance of less than 1/5 the length of the basal margin from the basi-scutal angle, 12-14 muscle attachment crests extend well beyond the basal margin, and the articular ridge projects beyond the articular margin. In *P. scutistriata* the spur is indistinct, not separated from the basi-scutal angle, the muscle attachment crests do not extend well beyond the basal margin, and the articular ridge projects beyond the articular margin.

Pachylasma laeviscutum sp. nov. differs from *P. darwinianum* as the rostral sutures are visible internally but not externally in the latter species. Additionally, *P. darwinianum* has a membranous basis, and the caudal appendages are extremely reduced, being represented by swollen mounds, whereas *P. laeviscutum* has 8-9 segmented caudal appendages which are the height of the basal segment of the pedicel of cirrus VI. The S of *P. darwinianum* externally has strongly convoluted growth lines which are not cut by longitudinal striae, whilst those of *P. laeviscutum* are slightly sinuous and cut by traces of 2-3 faint longitudinal striations. The T spur of *P. laeviscutum* is more than 1/3 the length of the basal margin, whereas the spur is absent in *P. darwinianum*.

Pachylasma laeviscutum differs from *P. ecaudatum, P. bacum* sp. nov. and *P. giganteum* because in these latter species the rostral sutures are obscure. The form and length of the caudal appendages (equal to the length of the basal segment of the pedicel of cirrus VI in *P. laeviscutum,* extremely reduced in *P. ecaudatum* and *P. bacum*, and 1/3 longer than the pedicel of cirrus VI in *P. giganteum*) further separate these species. There are also differences regarding the form of S and T between these species. The scutal growth ridges are slightly sinuous, not fluted, and cut by traces of 2-3 slight radial striations in *P. laeviscutum*; the S of *P. ecaudatum* has convoluted growth ridges cut by 8 radial striations; the S of *P. bacum* sp. nov. has extremely convoluted growth ridges, cut by 10-14 radial striations, giving it a 'beaded' appearance; and the S of *P. giganteum* has prominent, sinuous growth ridges cut by 4-6 slight longitudinal furrows. The T of *P. laeviscutum* has prominent growth ridges which are angularly upturned close along the scutal margin, longitudinal striations in the carinal area over the depressor muscle region, and a short spur more than 1/3 the length of the basal margin and set at 1/9 the length of the basal margin from the basi-scutal angle. The T of *P. ecaudatum* has prominent growth ridges and a slight ridge parallel to the S margin where the growth ridges are angularly upturned, and an indistinct spur which is 3/8 the length of the basal margin and set at 1/8 the length of the basal margin from the basi-scutal angle. The T of *P. bacum* sp. nov. has prominent, regular growth ridges and a short, broad spur which is 1/2 the width of, and almost indistinguishable from, the basal margin, set at distance of 1/10 the length of the basal margin from the basi-scutal angle. The T of *P. giganteum* has prominent growth ridges, which are angularly upturned close along the scutal margin, and a short, broad spur which is 1/2 the width of the basal margin and set at a distance of 1/7 the length of the basal margin from the basi-scutal angle.

Pachylasma laeviscutum sp. nov. differs from *P. integrirostrum* as in the latter the basal width of CL^1 is almost twice the basal width of CL^2, rather than equal to the basal width of CL^2. The S growth ridges of *P. integrirostrum* are feeble with no radial striations, whilst those of *P. laeviscutum* are slightly sinuous and cut by 2 to 3 faint longitudinal striae. The T of *P. integrirostrum* has feeble growth ridges, a broad spur which is 1/2 the width of the basal margin and 4-6 muscle attachment ridges which do not extend beyond the basal margin. The T of *P. laeviscutum* has well marked growth ridges, a broad spur which extends more than 1/3 the width of the basal margin and 13-18 muscle attachment ridges which extend beyond the basal margin.

ETYMOLOGY. — From *scutum*, and the Latin *laevis*, 'smooth', in reference to the smooth, slightly sinuous scutal growth ridges.

DISTRIBUTION. — Vanuatu, 140-466 m; New Caledonia, 215-420 m; Norfolk Ridge, 260-350 m; Futuna Island, 224-440 m.

Source : MNHN, Paris

Pachylasma ovatum sp. nov.

Figs 19, 26-28; Tables 9-11

MATERIAL EXAMINED. — **New Caledonia**. LAGON: stn 444, 300-350 m: 1 specimen (MNHN-Ci 2401). Drawn.
MUSORSTOM 4: stn CP 193, 415 m: 1 specimen, attached to a sponge (MNHN-Ci 2400); 1 specimen, attached to coral rubble.
BATHUS 4: stn DW 914, 600-616 m: 2 specimens, attached to sponges. — Stn DW 924, 344-360 m: 1 specimen, attached to coral rubble (WAM 254 -96).

TYPES. — *Holotype*: MNHN-Ci 2400 (MUSORSTOM 4, stn CP 193).
Paratypes: MNHN-Ci 2401 (LAGON, stn 444). Drawn. — WAM 254-96 (BATHUS 4, stn DW 924).

DIAGNOSIS. — Rostral plate sutures visible, basal width of R equal to basal width of RL. Basal width of CL^2 7/8 basal width of CL^1. S growth ridges convoluted, cut by 12-15 radial striations; articular ridge projecting. T with regular growth ridges; spur almost indistinguishable from basal margin, width 2/5 length of basal margin; 12-14 muscle attachment ridges extending well beyond basal margin; articular ridge projecting. Caudal appendages absent.

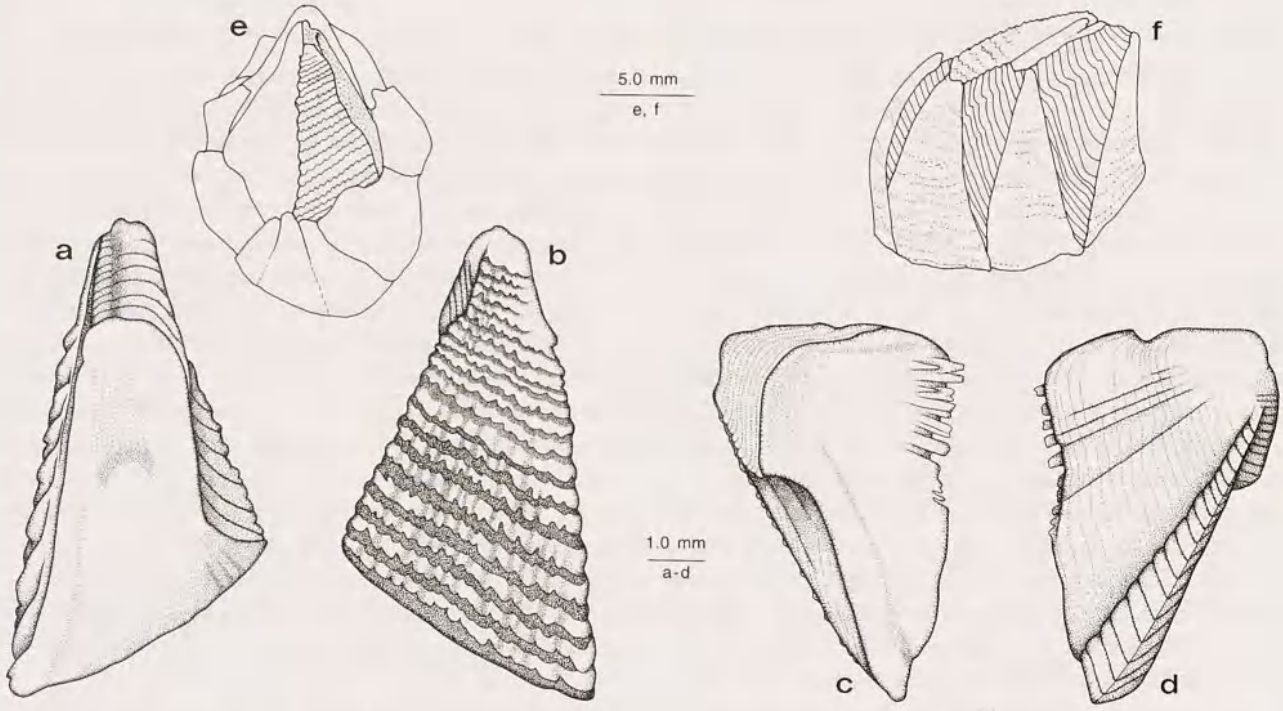

FIG. 26. — *Pachylasma ovatum* sp. nov. Paratype from LAGON, stn 444 (MNHN-Ci 2401): **a**, S, internal view; **b**, S, external view; **c**, T, internal view; **d**, T, external view; **e**, whole animal, from above (right S and T removed); **f**, whole animal, lateral view.

DESCRIPTION. — Size large (maximum: RC length 14.6, C height 10.7). Shell form oval from above. Parietal plates thick, growth ridges not well-defined, irregular; apices of rostral and CL^1 plates curved in toward orifice. Rostral plate convex; sutures visible internally and externally (sometimes obscure externally), dividing plate into 3 subequal parts; apex curved in toward orifice. CL^1 and CL^2 separate; basal width of CL^1 equal to basal width of rostral plate; basal width of CL^2 7/8 basal width of CL^1; apices of CL^1 and CL^2 curved in toward orifice. C convex; apex curving out from orifice; basal width of C equal to basal width of CL^1 and of rostral plate; shorter than, or approaching height of, R. Alae wide, triangular, those of C widest, alae of CL^1 and CL^2 equal in size,

Source : MNHN, Paris

width 1/2 width of carinal ala; superior alar margins finely serrate, oblique; alar growth ridges parallel to inferior alar margin. Basis thin, calcareous, centrally membranous. Orifice large, wide, roundly pentagonal; not toothed. Basis calcareous at edges, membranous centrally. Opercular plates lodged subparallel to basis. S triangular, elongated, basal margin greater than 1/2 length of occludent margin; apex bluntly pointed; externally with convoluted growth ridges, cut by 12-15 radial striations; internally adductor muscle pit in middle of valve; few short crests for lateral depressor muscle in shallow pit; articular furrow narrow, shallow; articular ridge running 3/4 length of valve, extending beyond articular margin; adductor ridge indistinct. T similar size to S, wide, triangular; externally growth ridges regular; internally with 12-14 strong muscle crests projecting beyond basal margin; articular ridge short, well-developed, prominent, extending beyond articular margin; articular furrow well-developed; spur short, almost indistinguishable from basal margin, width 2/5 width of basal margin, set at distance of 1/5 width of basal margin from basi-scutal angle. Color of parietal and opercular plates dirty creamy white. Measurements of 4 specimens examined as follows:

	RC length	LD	C height	R height
rg	10.0-14.6	9.0-19.8	3.6-10.7	4.7-9.2
$\bar{x}$	12.8	13.0	7.5	6.9

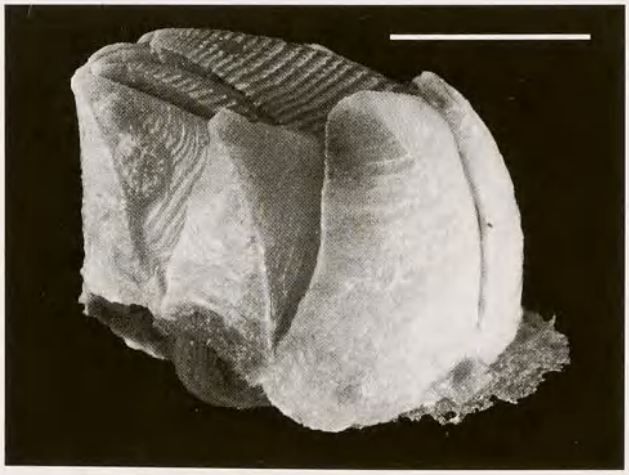

FIG. 27. — *Pachylasma ovatum* sp. nov. Holotype from MUSORSTOM 4, stn CP 193 (MNHN-Ci 2400): lateral view. Scale = 5 mm.

Labrum with shallow medial depression, small teeth present, bi- or tricuspid. Mandibular palp wide, ovate; dense, serrate setae terminally. Mandible with 3 teeth, tooth 1 separated from teeth 2 and 3; upper margins of 2 and 3 with small subsidiary cusps; inferior angle molariform, strongly dentate. Maxillule with 1 pair of long, stout setae at upper angle; notch below upper angle broad, with 4-5 pairs of smaller setae; cutting margin below almost straight, with 5-7 pairs of longer, stout setae; inferior angle slightly protuberant, with 7-9 pairs of small setae. Maxilla wide; lobes subequal; long serrulate setae distally.

Cirrus I with rami subequal; anterior ramus slightly longer than posterior; proximal segments of anterior ramus anteriorly protuberant; both rami with segments moderately setose. Cirrus II similar to but longer than cirrus I; rami subequal; proximal segments of anterior ramus anteriorly slightly protuberant, all segments setose, setae simple or serrulate, serrulate setae distally; antenniform distal segments of posterior ramus with tuft of setae and spines at posterior distal margins. Cirrus III longer than cirrus II; rami subequal, segments becoming oblong distally; posterior ramus with 3-5 pairs of long, finely serrulate setae on anterior faces of distal segments; anterior ramus with 3-5 pairs of long, finely serrulate setae on anterior faces of distal segments, proximal segments with 10 pairs. Cirrus IV to VI similar, longer than cirrus III; segments oblong, with 5 pairs of setae on anterior faces, distal 2 pairs longest, finely serrulate; distal segments of posterior ramus with spines at distal margin. Chaetotaxy ctenopod. Cirral formula as follows:

Paratype:		C I	C II	C III	C IV	C V	C VI	c. a.
MNHN-	left	11, 11	17, 20	22, 24	25, 26	26, 28	26, 26	absent
Ci 2401	right	11, 12	17, 16	18, 21	24, 26	26, 27	26, 27	absent

Penis 1/2 length of basal segment of pedicel of cirrus VI; sparsely setose; tufts of long setae distally. Caudal appendages absent.

Source : MNHN, Paris

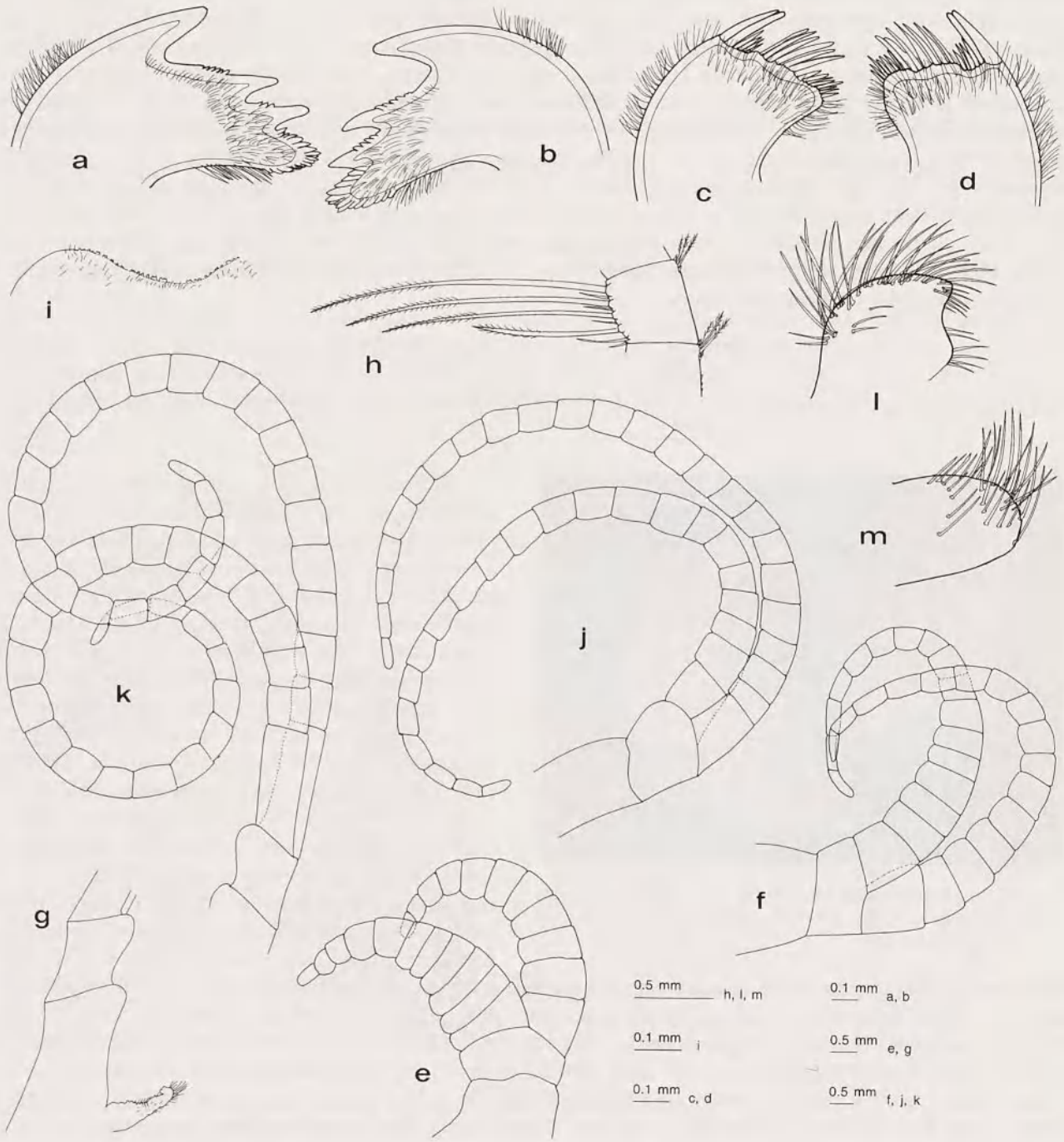

FIG. 28. — *Pachylasma ovatum* sp. nov. Paratype from LAGON, stn 444 (MNHN-Ci 2401): **a**, right mandible; **b**, left mandible; **c**, right maxillule; **d**, left maxillule; **e**, cirrus I; **f**, cirrus II; **g**, pedicel of cirrus VI and penis; **h**, cirrus VI, posterior ramus, median segments; **i**, labrum; **j**, cirrus III; **k**, cirrus VI; **l**, maxilla; **m**, mandibular palp.

REMARKS. — *Pachylasma ovatum* sp. nov. is similar to *P. scutistriata* but they may be separated by a number of characters. In *P. ovatum* the basal width of CL^2 is 7/8 the basal width of CL^1, rather than equal to the basal width (*P. scutistriata*). The caudal appendages are absent in *P. ovatum* rather than 15-18 segmented and a little longer than the pedicel of cirrus VI (*P. scutistriata*). In *P. ovatum* the S growth ridges are moderately convoluted

Source : MNHN, Paris

and divided by 12-15 radial striations; in *P. scutistriata* they are distinctly convoluted and divided by a few radial striations. There are also differences in the form of the T - the muscle attachment crests do not project beyond the basal margin in *P. scutistriata,* but there are 12-14 well-developed muscle crests projecting well beyond the basal margin in *P. ovatum*; the tergal spur is 2/5 the width of the basal margin and set at a distance of less than 1/5 the width of the basal margin from the basi-scutal angle in *P. ovatum,* but the spur is indistinct, 1/3 the width of the basal margin and not separated from the basi-scutal angle in *P. scutistriata*; and the tergal articular ridge extends much further beyond the articular margin in *P. scutistriata* than in *P. ovatum*. In addition, the parietal plates of *P. scutistriata* are pale pink colored with white alae, whilst those of *P. ovatum* are dirty creamy white.

ETYMOLOGY. — From the Latin *ovatum*, 'oval', in reference to the ovate form of the basis.

DISTRIBUTION. — New Caledonia, 300-616 m.

Pachylasma scutistriata Broch, 1922

Fig. 19; Tables 9-11

Pachylasma scutistriata Broch, 1922: 301, figs 48-50. — NILSSON-CANTELL, 1927: 781. — POPE, 1965: 10. — UTINOMI, 1968: 26, figs 4-5. — NEWMAN & ROSS, 1976: 40. — FOSTER, 1978: 77, fig. 47, pl. 9 E-F.

MATERIAL EXAMINED. — **Australia**. *"Endeavour"*: 38°12'S, 149°40'E, 256-274 m, 16.09.1914: holotype (ZMC Cru 1978). — E of East Sister Island, Bass Strait, 104-110 m: 1 dry specimen (AM E 6629). — SE Australia, few specimens, on alcyonarian stock covered by anemones (AM P 23757).

TYPES. — *Holotype*: ZMC Cru 1978; Australia, *"Endeavour"*, 38°12'S, 149°40'E, 256-274 m, 16.09.1914; 2 slides plus material in alcohol.
Paratypes: AM E 6565; Australia, *"Endeavour"*, 38°12'S, 149°40'E, 256-274 m, 16.09.1914; ZMC Cru 1978.
Holotype depository: ZMC.
Paratypes depository: ZMC, AM.

DIAGNOSIS. — Rostral plate shortest plate; sutures visible, basal width R equal to basal width RL. Basal width of CL^1 equal to basal width of CL^2. S externally with growth ridges convoluted, cut with many radial striations; articular ridge slightly projecting. T with faint growth ridges, spur almost indistinguishable from basal margin, width 1/3 length of basal margin, set at basi-scutal angle; prominent articular ridge projecting beyond scutal margin; muscle attachment ridges not extending beyond basal margin. Caudal appendages slightly longer than pedicel of cirrus VI, 15-18 segments.

REMARKS. — Size large (maximum: RC length 20.0, C height 15.0). *Pachylasma scutistriata* is similar to *P. ovatum* sp. nov. but they may be separated by a number of characters, which are listed in the Remarks section under *P. ovatum* sp. nov. The vivid pink color of the parietal plates, and the form of the caudal appendages (15-18 segmented and a little longer than the pedicel of cirrus VI) separate *P. scutistriata* from the remaining species presently included within *Pachylasma.*

DISTRIBUTION. — Indian Ocean to New Zealand, Japan, South China Sea to Malaysia, 104-2050 m.

Genus ***EURYLASMA*** gen. nov.

Fig. 29; Tables 3-4, 12-14

DIAGNOSIS. — Adult externally with fixed shell pattern of 6 parietal plates (R-CL^1-CL^2-C). Rostral plate with sutures obscure, or visible externally and internally with R reduced to narrow sliver, RL correspondingly well developed, basal width of RL 3 times or 6 times basal width of R. CL^1 and CL^2 partially coalesced, coalescence

Source : MNHN, Paris

incomplete as CL^2 retains minute ala. S concave externally; pyramidal or sub-pyramidal in form. Length of caudal appendages ranging from 1/2 height of distal segment of pedicel of cirrus VI to longer than pedicel of cirrus VI by 1/4; 5-13 segments.

TYPE SPECIES. — *Eurylasma angustum* sp. nov.

RECENT SPECIES. — *Eurylasma angustum* sp. nov.; *E. ferulum* sp. nov.; *E. pyramidale* sp. nov.

TABLES 12 and 13. — *Eurylasma*: characters of the species

	no. plates ext.	no. plates int.	R:RL	CL^1: CL^2	T	basis
E. angustum sp. nov.	6	8	basal width RL = 3 x basal width R; apical width RL = apical width R	partially coalesced, but CL^2 retains ala; basal width CL^2 = 1/2 basal width CL^1; height CL^2 3/4 height of CL^1	not proj.; spur indistinct, 5/9 width of basal margin, not separated from b-s angle; 7-9 muscle crests extending well beyond basal margin	calcareous
E. ferulum sp. nov.	6	8	basal width RL = 6 x basal width R; apical width RL = 2 x apical width R	partially coalesced, but CL^2 retaining ala; basal width CL^2 = 3/4 basal width CL^1; height CL^2 9/10 height of CL^1	not proj.; spur indistinct, 1/2 width basal margin, not separated from b-s angle; 16-20 muscle crests, not extending beyond basal margin	calcareous
E. pyramidale sp. nov.	6	6	n.a.	partially coalesced, but CL^2 retaining ala; basal width CL^2 = 9/10 basal width CL^1; height CL^2 8/9 height of CL^1	not proj.; spur indistinct, 2/3 width basal margin, not separated from b-s angle; 10-14 muscle crests barely extending beyond basal margin	calcareous

b-s = basi-scutal; ext. = external; int. = internal; n. a. = not applicable; proj. = projecting.

	S shape	S growth lines	c.a.	mandible
E. angustum sp. nov.	concave externally in upper 1/3; tending to sub-pyramidal; S basal margin 3/5 length of occludent margin, curved toward artic. margin at point 2/3 length of basal margin from occludent margin; S artic. ridge not proj.	convoluted; not cut by long. striae	5-6 segs; 1/2 height of distal segment of pedicel of CVI	tridentate; upper margins of teeth 2 and 3 often with small subsidiary cusps
E. ferulum sp. nov.	concave externally in middle region; sub-pyramidal; S basal margin 2/5 length of occludent margin, bent at almost 90° toward artic. margin at point 2/3 length of basal margin from occludent margin; S artic. ridge not proj.	convoluted; not cut by long. striae	11-12 segs; = height of pedicel of CVI	tridentate; upper margin of tooth 3 with small subsidiary cusps
E. pyramidale sp. nov.	pyramidal; concave externally in upper 1/2; S basal margin 5/12 length of occludent margin, bent at almost 90° toward artic. margin at point 2/3 length of basal margin from occludent margin; S artic. ridge not proj.	convoluted; cut by many faint, long. striae, giving slight beaded effect	13 segs; longer than pedicel of CVI by 1/4	tridentate; upper margins of teeth 2 and 3 with strong subsidiary cusps

artic. = articular; c.a. = caudal appendage; long. = longitudinal; max. = maximum; proj. = projecting; segs = segments.

TABLES 14. — *Eurylasma*: maximum size, geographical and bathymetrical distribution of the species

	size (max.)	distribution	depth
E. angustum sp. nov.	RC length 9.7; C height 7.5	Loyalty Is, Vanuatu	295-400 m
E. ferulum sp. nov.	RC length 15.0; C height 10.6	Norfolk Ridge	460-470 m
E. pyramidale sp. nov.	RC length 14.1; C height 6.7	Norfolk Ridge	255-365 m

REMARKS. — The well developed carinal alae, and the partial coalescence of CL^1 and CL^2, with the concomitant reduction of the ala of CL^2, are characteristic of the genus. In addition, the angle of lodgement of the

Source : MNHN, Paris

opercular plates in the orifice, and the curved form of the S, due to its external concavity, plus the almost right-angle formed by the basal and tergal margins (resulting in the sub-pyramidal to pyramidal form), are unique characters. Furthermore, in species where the rostral sutures are visible, the reduction of R to a narrow sliver, associated with the great development of RL, are characters not found in any other pachylasmatine genera. Species included herein are moderate (maximum: RC length 9.7, C height 7.5) to large (maximum: RC length 15.0, C height 10.6) in size and have been found attached to gorgonians and *Corallium* species.

In *Eutomolasma* sp. nov., *Microlasma* sp. nov. and *Pachylasma*, CL^1 and CL^2 are discrete entities, resulting in the adult fixed wall pattern of 6 plates. CL^1 and CL^2 are coalesced to a certain degree in *Eurylasma* sp. nov. although the ala of CL^2 is still evident, albeit reduced. This arrangement also results in an adult fixed wall pattern of 6 parietal plates. In *Tetrapachylasma,* CL^1 and CL^2 may be coalesced, partially or totally, resulting in a variable shell pattern in the adult of 6 (partial coalescence of CL^1 and CL^2) or 4 (total coalescence of CL^1 and CL^2) parietal plates.

ETYMOLOGY. — From the Greek *eurys*, 'wide', in reference to the characteristically broad carinal alae of species included in this genus.

DISTRIBUTION. — Western Pacific Ocean: Norfolk Ridge, 255-365 m (*E. pyramidale*); Norfolk Ridge, 460-470 m (*E. ferulum*); Vanuatu, Loyalty Islands, 295-400 m (*E. angustum*).

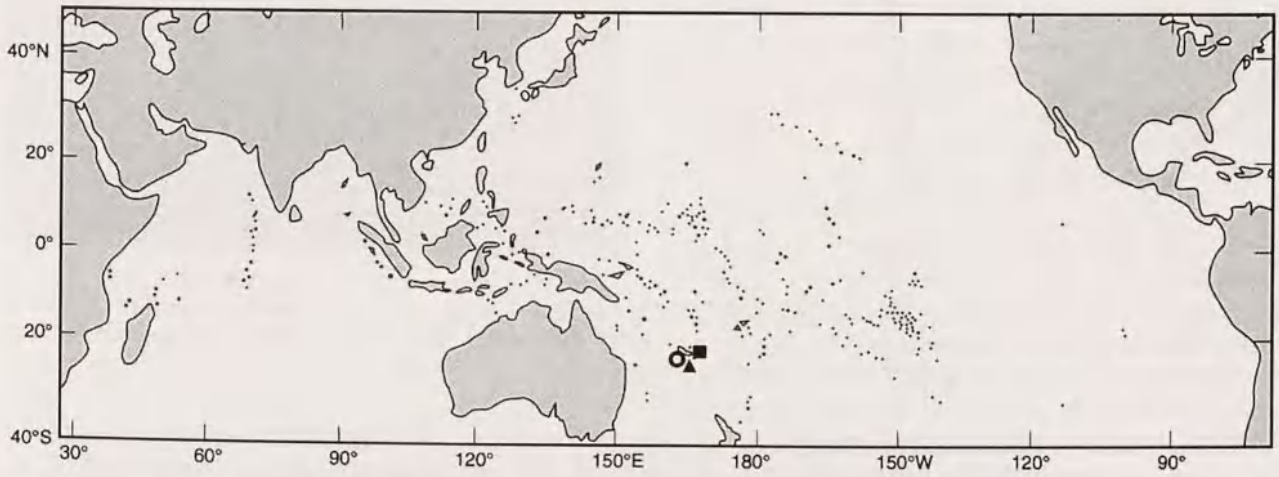

FIG. 29. — *Eurylasma* gen. nov. Distribution map: ○, *E. pyramidale* sp. nov. (255-365 m); ▲, *E. ferulum* sp. nov. (460-470 m); ■, *E. angustum* sp. nov. (295-400 m).

Eurylasma angustum sp. nov.

Figs 29-32; Tables 12-14

MATERIAL EXAMINED. — **Loyalty Islands**. MUSORSTOM 6: stn DW 478, 400 m: several specimens, attached to gorgonian (MNHN-Ci 2402, Ci 2504). Drawn.

Vanuatu. MUSORSTOM 8: stn DW 967, 295-334 m: 2 specimens, attached to gorgonian (WAM C 23250). — Stn DW1060, 375-397 m: 1 specimen, attached to gorgonian (MNHN-Ci 2698).

TYPES. — *Holotype*: MNHN-Ci 2402 (MUSORSTOM 6, stn DW 478).

Paratypes: MNHN-Ci 2504 (MUSORSTOM 6, stn DW 478). Drawn. — WAM C 23250 (MUSORSTOM 8, stn DW 967). — MNHN-Ci 2698 (MUSORSTOM 8, stn DW 1060).

DIAGNOSIS. — Rostral plate with sutures visible, R reduced to sliver; basal width of RL 3 times basal width of R; apical width RL equal to apical width R. CL^1 and CL^2 partially united; CL^2 3/4 height, 1/2 basal width

Source : MNHN, Paris

of CL^1. S elongated, triangular tending to sub-pyramidal, growth ridges convoluted, longitudinal striations absent. T with 7-9 muscle crests extending well beyond basal margin. Caudal appendages extending 1/2 height of distal segment of pedicel of cirrus VI, 5-6 segments.

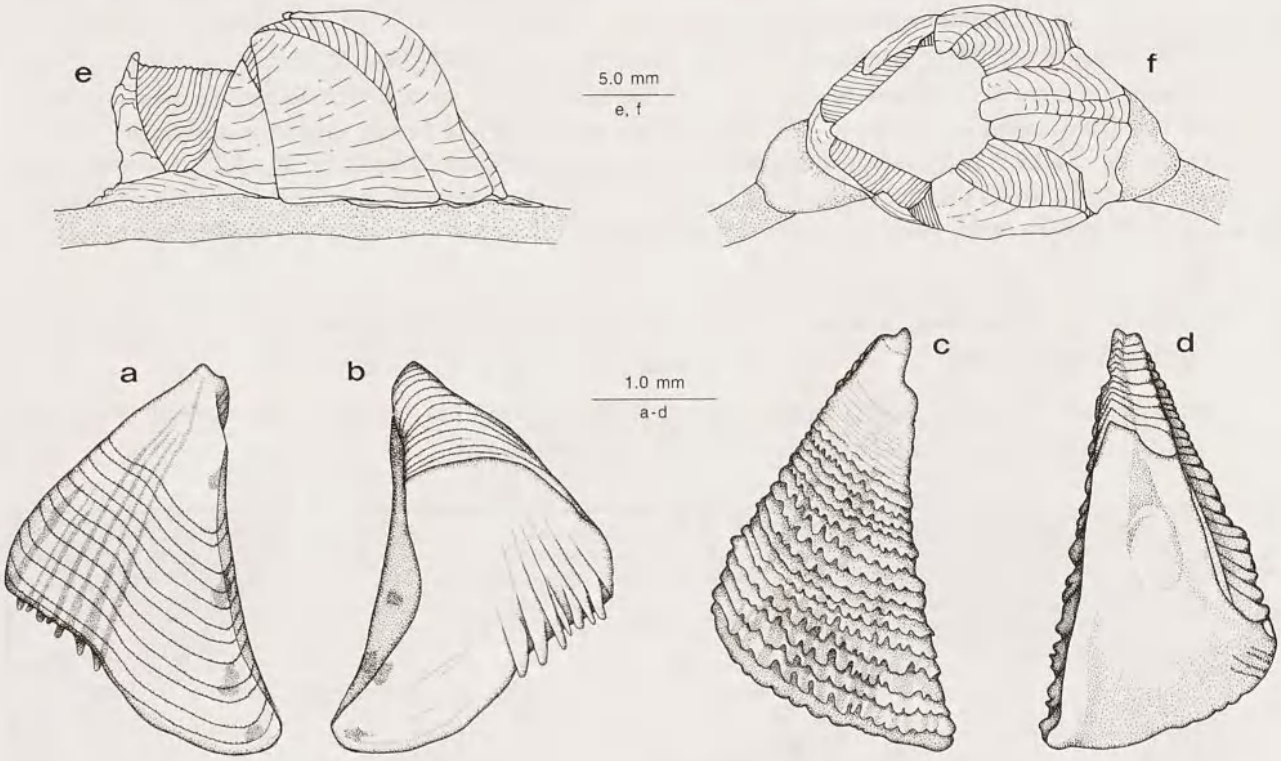

FIG. 30. — *Eurylasma angustum* sp. nov. Paratype from MUSORSTOM 6, stn DW 478, attached to axis of gorgonian (MNHN-Ci 2504): **a**, S, external view; **b**, S, internal view; **c**, T, external view; **d**, T, internal view; **e**, whole animal, lateral view; **f**, whole animal, from above (right S and T removed).

DESCRIPTION. — Size moderate (maximum: RC length 9.7, C height 7.5). Shell form rounded oval, depressed at carinal end. Parietal plates rough textured basally, smoother apically, growth ridges not deeply marked; all parietes except C curving in toward orifice; orifice pentagonal. Rostral plate convex, almost bowed, basal width equal to basal width of CL^1, wider and higher than C; apex well curved in toward orifice; rostral sutures visible externally and internally, R reduced to narrow sliver; RL tapering, basal width 3 times basal width of R, apical width equal to apical width of R. CL^1 and CL^2 partially united but CL^2 retaining small ala, suture line visible externally; basal width of CL^1 subequal to basal width of rostral plate, apex of CL^1 curving toward orifice; CL^2 3/4 height, 1/2 basal width of CL^1; apex of CL^2 slightly curving toward orifice. C bowed, basal width equal to basal width of CL^1; height 7/10 rostral height; apex erect, not spout-like. Alae of C wide, growth ridges sinuously parallel to inferior alar margins, superior alar margins subparallel to basis; alae of CL^2 1/4 width of carinal alae, alae of CL^1 1/2 width of carinal alae; superior alar margins minutely serrate. Basis calcareous, thin centrally; flat, central groove axis of gorgonian host. Orifice pentagonal from above, not toothed. Opercular plates placed parallel to basis; slightly sunken down in orifice in rostral area, then gently curving upward at angle of 30°, due to concave form of scuta. S elongated, triangular tending to subpyramidal, basal margin 3/5 length of occludent margin; basal margin without angled bend, but curved toward articular margin at point 2/3 length of basal margin from occludent margin; externally valve concave in upper 1/3, lower 1/3 retroverted away from concavity (thus curved in side-view); externally with regular, convoluted growth ridges, longitudinal striations absent; apex acute; internally muscle scar visible at 2/3 height of valve, small lateral depressor muscle crests developed; articular furrow narrow; articular ridge not projecting beyond articular margin; adductor ridge indistinct.

Source : MNHN, Paris

T larger than S, triangular, slightly higher than wide; externally with well-spaced growth ridges; internally with 7-9 strong muscle crests extending well beyond basal margin; articular ridge not extending beyond articular margin; articular furrow shallow; spur indistinct, short, set at basi-scutal angle, occupying 5/9 width of basal margin. Color of preserved material creamy lemon-yellow with darker pinkish-orange markings on opercular plates, C and carinal alae; color after bleaching pearly white with hint of shell pink, C rose-pink with color suffusing onto carinal alae; eggs orange-yellow. Measurements of 8 specimens examined, randomly selected from several stations, as follows:

	RC length	LD	C height	R height
rg	3.7-9.7	3.2-7.5	2.3-7.5	2.2-7.1
$\bar{x}$	6.3	4.6	3.8	4.0

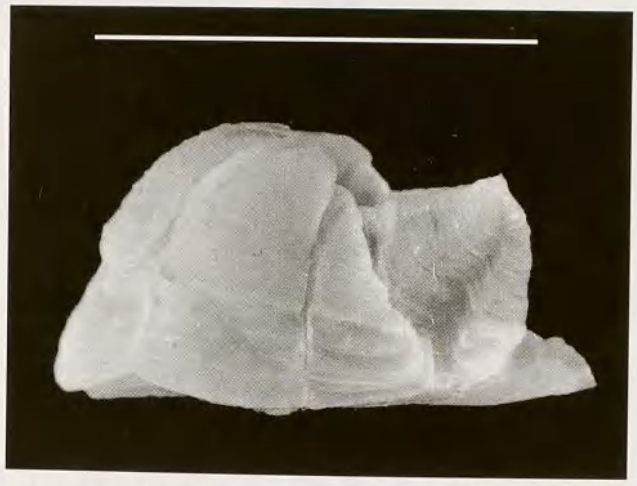

FIG. 31. — *Eurylasma angustum* sp. nov. Holotype from MUSORSTOM 6, stn DW 478, attached to axis of gorgonian (MNHN-Ci 2402): lateral view. Scale = 5 mm.

Labrum with shallow median depression, small teeth and setae present. Mandibular palp ovate, with moderately dense, finely serrulate setae terminally. Mandible with 3 teeth, tooth 1 largest, separated from teeth 2 and 3; upper margins of 2 and 3 with or without small subsidiary cusps; inferior angle acutely molariform, dentate. Maxillule setose, with pair of long setae at upper angle; wide notch below upper angle with 4-6 pairs shorter setae, cutting edge below almost straight, with 5-7 pairs longer setae, inferior angle slightly protuberant, with 4-6 short setae. Maxilla wide, coxal endite weakly defined; long serrulate setae apically.

Cirrus I with rami subequal; anterior ramus slightly longer than posterior; proximal segments of anterior and posterior rami moderately protuberant anteriorly; both rami moderately setose, setae finely serrulate distally. Cirrus II longer than cirrus I; rami subequal; proximal segments of anterior ramus moderately protuberant anteriorly; rami with segments moderately clothed with setae, some serrulate, especially distally; posterior ramus with fine spines at antero-distal angles of segments. Cirrus III longer than and similar to cirrus II, with rami subequal, segments becoming oblong distally; posterior ramus with 2-4 pairs of long, finely serrulate setae on anterior faces of distal segments; anterior ramus with 2-4 pairs of long, finely serrulate setae on anterior faces of more distal segments, proximal segments with 6 pairs. Cirrus IV to VI similar, longer than cirrus III; segments oblong, with 3-4 pairs of setae on anterior faces, distal 2 pairs longest, finely serrulate. Chaetotaxy ctenopod. Cirral formula as follows:

Paratype:		CI	CII	CIII	CIV	CV	CVI	c. a.
MNHN-	left	10, 9	10, 11	14, 14	15, 16	20, 18+	20, 23	6
Ci 2504	right	10, 10	10, 11	14, 15	14, 16	18, 20	21, 20	5

Caudal appendages 1/2 height of distal segment of pedicel of cirrus VI; 5-6 segmented; long setae apically, with circlets of sparse, fine setae around distal margins of segments, length of setae 2/3 length of segment. Penis 1/2 length of cirrus VI; finely annulated; sparsely setose with circlet of long setae distally. Eggs large, 0.37 x 0.43 mm.

REMARKS. — *Eurylasma angustum* may be distinguished from *E. pyramidale* sp. nov. by the form of the rostral sutures (visible in the former, obscure in the latter); by differences in the relative proportions of the

Source : MNHN, Paris

CL plates (the basal width of CL^2 is 1/2 the basal width of CL^1 in *E. angustum*, and 9/10 the basal width of CL^1 in *E. pyramidale*); by the form of the S (tending toward sub-pyramidal in *E. angustum*, pyramidal in

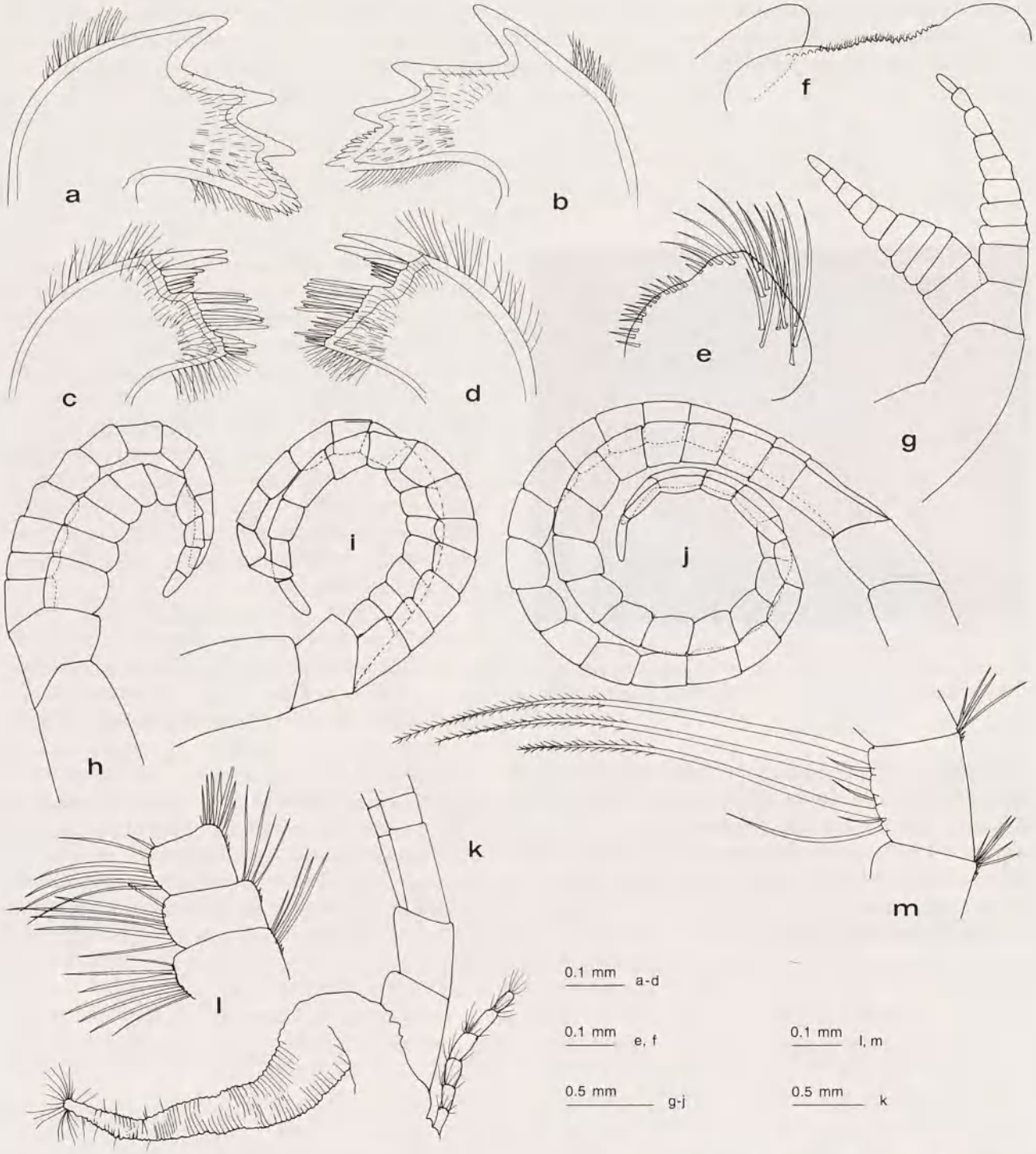

FIG. 32. — *Eurylasma angustum* sp. nov. Paratype from MUSORSTOM 6, stn DW 478, attached to axis of gorgonian (MNHN-Ci 2504): **a**, right mandible; **b**, left mandible; **c**, right maxillule; **d**, left maxillule; **e**, maxilla; **f**, labrum; **g**, cirrus I; **h**, cirrus II; **i**, cirrus III; **j**, cirrus VI; **k**, pedicel of cirrus VI, penis and caudal appendage; **l**, cirrus I, posterior ramus, median segments; **m**, cirrus VI, posterior ramus, median segment.

Source : MNHN, Paris

E. pyramidale); by the form of the T (spur of *E. angustum* is 5/9 the width of the basal margin and there are 7-9 strong muscle crests extending well beyond the basal margin; the spur of *E. pyramidale* is 2/3 the width of the basal margin and there are 10-14 muscle crests barely extending beyond the basal margin); by the length of the caudal appendages (5-6 segments and 1/2 the height of the distal segment of the pedicel of cirrus VI, rather than 13 segments and longer than the pedicel of cirrus VI by 1/4); by the dentition of the mandible (strong subsdiary cusps on the upper margins of teeth 2 and 3 in *E. pyramidale*, small cusps often on upper margins of teeth 2 and 3 in *E. angustum*); by the size (maximum RC length 9.7, 14.1 respectively); and by the color (creamy lemon-yellow with darker pinkish-orange markings).

Eurylasma angustum is similar to *E. ferulum* sp. nov. but R is more reduced in the latter (basal width RL 6 times basal width of R, rather than 3 times), and the basal width of CL^2 is 1/2 the basal width of CL^1 in *E. angustum*, and 3/4 the basal width of CL^1 in *E. ferulum*. The rostral plate is higher than the C in *E. angustum* (C 7/10 the height of the rostral plate), but the rostral plate is shorter (5/6 the height of the C) in *E. ferulum*. The T spur of *E. angustum* is 5/9 the width of the basal margin and there are 7-9 strong muscle crests extending well beyond the basal margin; the spur of *E. ferulum* is 1/2 the width of the basal margin and there are 16-20 strong muscle crests which do not extend beyond the basal margin. The form and length of the caudal appendages (5-6 segments and 1/2 the height of the distal segment of the pedicel of cirrus VI in *E. angustum*, 11-12 segments and equal to the height of the pedicel of cirrus VI in *E. ferulum*) further separate these two species.

ETYMOLOGY. — From the Latin *angustus*, 'very narrow', in reference to the very narrow form of the rostral plate.

DISTRIBUTION. — Vanuatu, Loyalty Islands, 295-400 m.

Eurylasma ferulum sp. nov.

Figs 29, 33-35; Tables 12-14

MATERIAL EXAMINED. — **Norfolk Ridge**. BATHUS 3: stn CP 815, 460-470 m: 1 specimen (MNHN-Ci 2405). Drawn.

TYPES. — *Holotype*: MNHN-Ci 2405 (BATHUS 3, stn CP 815). Drawn.

FIG. 33. — *Eurylasma ferulum* sp. nov. Holotype from BATHUS 3, stn CP 815 (MNHN-Ci 2405): lateral view. Scale = 5 mm.

DIAGNOSIS. — Rostral sutures visible, R reduced to narrow sliver; basal width of RL 6 times basal width of R. CL^1 and CL^2 partially united; CL^2 9/10 height of CL^1, basal width of CL^2 3/4 basal width of CL^1. S sub-pyramidal; externally with many extremely convoluted growth ridges, longitudinal striations absent. T with 16-20 muscle attachment crests not extending beyond basal margin. Caudal appendages height of pedicel of cirrus VI, 11-12 segments.

DESCRIPTION. — Size large (maximum: RC length 15.0, C height 10.6). Shell form elongate oval from above; all parietes curving in toward orifice. Parietal plates with smooth, regular growth ridges. Rostral plate convex, bowed, basal width subequal to basal width of C, height 5/6 height of C; apex curved in toward orifice; rostral sutures visible externally and internally; R reduced to narrow sliver; RL tapering apically, basal width of RL 6 times basal width of R, apical width of RL twice apical width of R. Basal width of CL^1 subequal to basal width of RL, apex

Source : MNHN, Paris

curved toward orifice. CL^1 and CL^2 partially united but CL^2 retaining minute ala; suture lines visible externally; height of CL^2 9/10 height of CL^1, basal width of CL^2 3/4 basal width of CL^1; apex slightly curving in toward orifice. C bowed, basal width subequal to basal width of rostral plate, C higher than rostral plate by 1/6; apex slightly curved toward orifice. Alae of C widest, growth ridges sinuously parallel to inferior alar margin, superior alar margins not parallel to basis, minutely serrate; alae of CL^2 1/10 width of carinal alae, alae of CL^1 2/5 width of carinal alae. Basis calcareous, thick; slightly cup-shaped, with central groove. Orifice subtriangular from above; not toothed. Opercular plates not parallel to basis, gentley curving upward from rostral end at angle of 40°, due to concave form of S. Basal margin of S 2/5 length of occludent margin; sub-pyramidal shape produced by almost 90° bend on basal margin toward articular margin, bend at 2/3 length of basal margin from occludent margin; externally middle area of valve concave, areas above and below retroverted away from concavity (thus curved in side-view); externally with many extremely convoluted growth ridges, producing frilled appearance; apex pointed; internally shallow adductor muscle scar at 2/3 height of valve; few small lateral depressor muscle crests developed; articular furrow narrow; articular ridge not projecting beyond articular margin; adductor ridge indistinct. T larger than S, triangular; externally with well-marked growth ridges; internally with 16-20 muscle crests, not extending beyond basal margin; articular ridge short, not projecting beyond articular margin; articular furrow wide; short spur set at basi-scutal angle, rounded, 1/2 width of basal margin. Color of preserved material mottled creamy/lemon yellow with C and CL alae more orange-ochre; opercular plates mottled orange-ochre and cream; basis creamy-white. Measurements of holotype as follows:

Holotype:	RC length	LD	C height	R height
MNHN-Ci 2405	15.0	9.0	10.6	8.7

Labrum with shallow medial depression; small teeth in irregular row, with some long fine setae; dense spicules on both sides of depression below teeth. Mandibular palp oblong; dense, serrate setae terminally. Mandible with

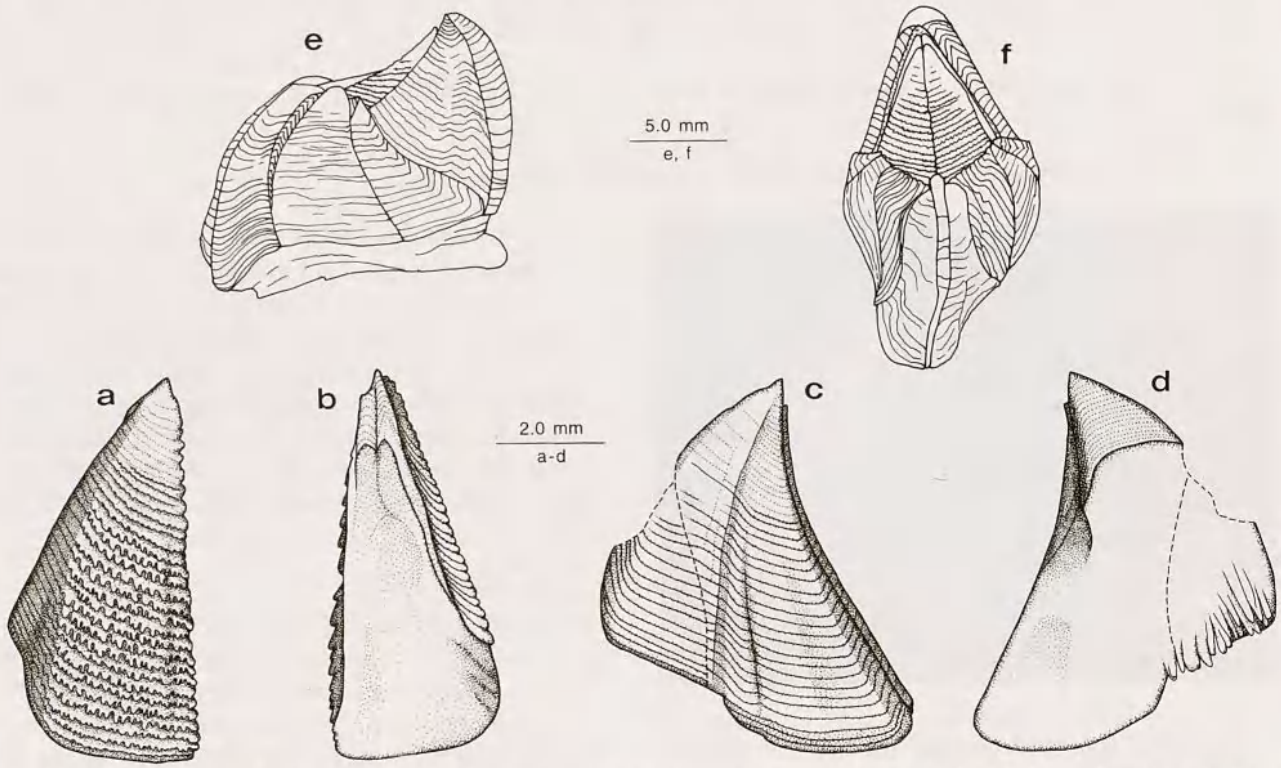

FIG. 34. — *Eurylasma ferulum* sp. nov. Holotype from BATHUS 3, stn CP 815 (MNHN-Ci 2405): **a**, S, external view; **b**, S, internal view; **c**, T, external view; **d**, T, internal view; **e**, whole animal, lateral view; **f**, whole animal, from above.

Source : MNHN, Paris

3 teeth, tooth 1 well-separated from 2 and 3; upper margin of 3 with small subsidiary cusps; inferior angle bluntly molariform, dentate. Maxilla wide, coxal endite barely defined; long serrulate setae terminally. Maxillule with 1-2 pairs of long, stout setae at upper angle; notch below upper angle moderately large, indistinct, with 4-5 pairs of smaller setae; cutting margin below almost straight, with 7-8 pairs of larger setae; inferior angle with 4-5 pairs of smaller setae and 1 longer seta.

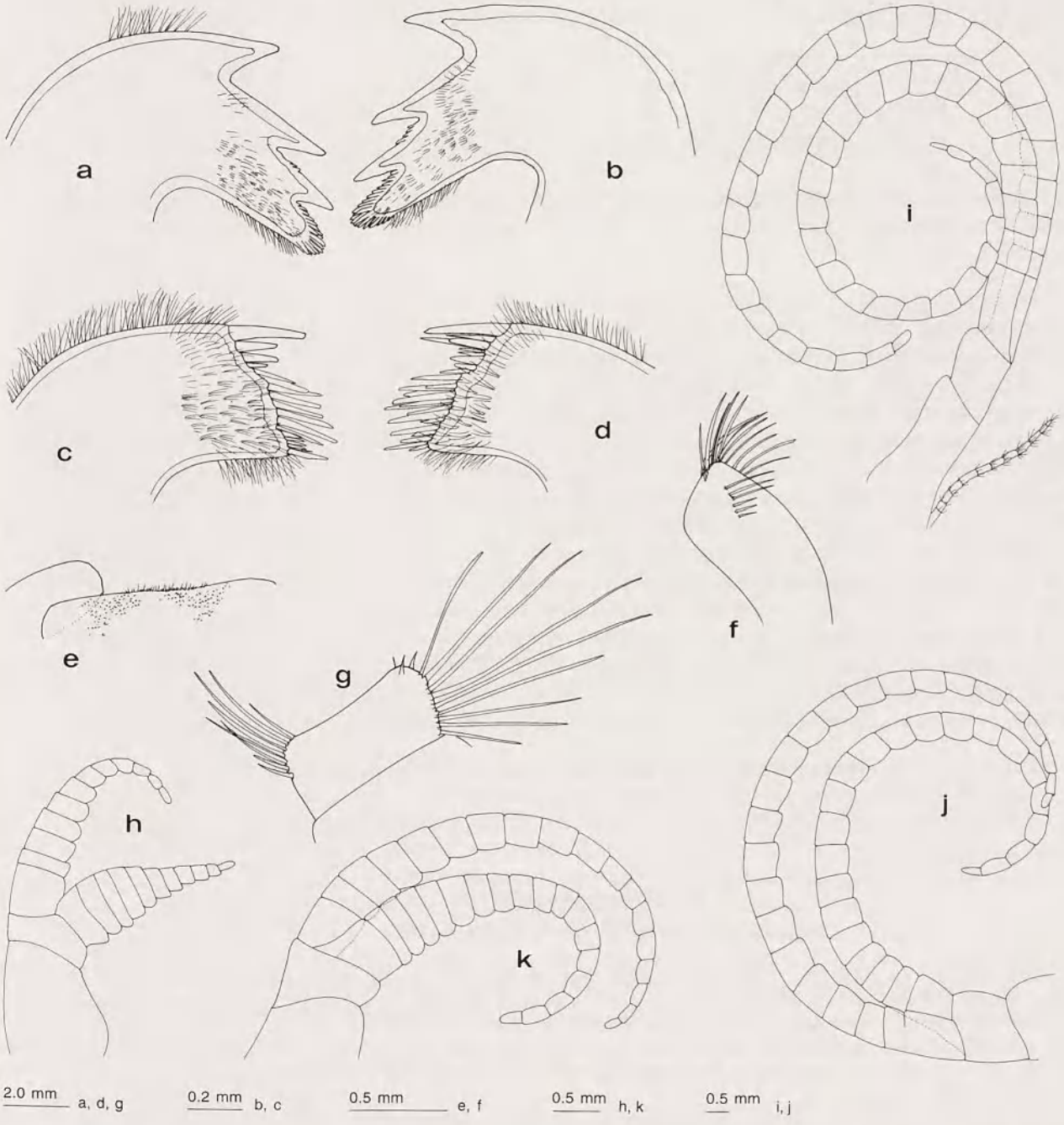

FIG. 35. — *Eurylasma ferulum* sp. nov. Holotype from BATHUS 3, stn CP 815 (MNHN-Ci 2405): **a**, right mandible; **b**, left mandible; **c**, right maxillule; **d**, left maxillule; **e**, labrum; **f**, mandibular palp; **g**, cirrus I, anterior ramus, median segments; **h**, cirrus I; **i**, cirrus VI; **j**, cirrus III; **k**, cirrus II.

Source : MNHN, Paris

Cirrus I with rami subequal; posterior ramus slightly longer than anterior; proximal segments of anterior ramus protuberant anteriorly; both rami thickly setose, setae finely serrulate distally. Cirrus II similar to cirrus III and longer than cirrus I; rami subequal; proximal segments of anterior ramus protuberant anteriorly; rami with segments thickly setose, setae finely serrulate, especially distally. Cirrus III with rami subequal, segments becoming oblong distally; posterior ramus with 2-4 pairs of long, finely serrulate setae on anterior faces of distal segments; anterior ramus with 2-3 pairs of long, finely serrulate setae on anterior faces of distal segments, proximal segments with 7 pairs. Cirrus IV to VI similar, longer than cirrus III; segments oblong, with 4-5 pairs of setae on anterior faces, distal 2 pairs longest, finely serrulate. Chaetotaxy ctenopod. Cirral formula of holotype as follows:

Holotype:		C I	C II	C III	C IV	C V	C VI	c. a.
MNHN-	left	13, 12	18, 19	21, 22	24, 25	28, 16+	28, 27	12
Ci 2405	right	11, 12	18, 18	23, 24	24, 26	11+, 26	27, 27	11

Caudal appendages length of pedicel of cirrus VI; 11-12 segmented; apically with sparse setae, circles of sparse setae around distal margins of segments, setal length 1/3 segmental length. Penis broken, basal remnant attached to cirrus VI.

REMARKS. — Only 1 specimen of this species has been collected, but the very narrow, sliver-like R, and characters of the shell and of the soft part morphology are sufficiently distinct to warrant specific differentiation. Differences between *E. ferulum* sp. nov. and *E. angustum* sp. nov. are listed under *E. angustum.*

Eurylasma ferulum sp. nov. is distinguished from *E. pyramidale* sp. nov. by the rostral sutures, obscure in the latter, visible in the former. The rostral plate and C are of equal height in *E. pyramidale*, whereas the C is higher than the rostral plate by 1/6 in *E. ferulum*. The form of the S is sub-pyramidal in *E. ferulum,* and the convoluted S growth lines are not cut by longitudinal striae. In *E. pyramidale* the S is pyramidal and the convoluted growth lines are cut by faint longitudinal striae, giving a slight beaded effect. In *E. ferulum* the T spur is 1/2 the width of the basal margin and has 16-20 muscle crests which do not extend beyond the basal margin; the spur of *E. pyramidale* is 2/3 the width of the basal margin and has 10-14 muscle crests barely extending beyond the basal margin. Cirrus I of *E. pyramidale* has the anterior ramus longer than the posterior, with the proximal segments of both rami protuberant anteriorly, whereas that of *E. ferulum* has the posterior ramus longer than the anterior with only the proximal segments of the anterior ramus protuberant. The caudal appendages of *E. ferulum* are 11-12 segmented and are equal to the height of the pedicel of cirrus VI, whilst those of *E. pyramidale* are 13 segmented and longer than the pedicel of cirrus VI by 1/4. The upper margins of mandibular teeth 2 and 3 have many small subsidiary cusps in *E. pyramidale*; only the upper margin of tooth 3 has small subsidiary cusps in *E. ferulum.*

ETYMOLOGY. — From the Latin *ferula*, 'rod', referring to the rod-like nature of the R.

DISTRIBUTION. — Norfolk Ridge, 460-470 m.

Eurylasma pyramidale sp. nov.

Figs 29, 36-38; Tables 12-14

MATERIAL EXAMINED. — **Norfolk Ridge**. SMIB 5: stn DW 71, 265 m: 1 specimen, attached to live coral (*Corallium* sp.) (MNHN-Ci 2404). — Stn DW 75, 270 m: 1 specimen, attached to live coral (*Corallium* sp.). — Stn DW 93, 255 m: 1 specimen, attached to live coral (*Corallium* sp.) (MNHN-Ci 2403); many specimens, attached to live coral (*Corallium* sp.) (BMNH); many specimens, attached to live coral (*Corallium* sp.) (USNM). — Stn DW 94, 275 m: several specimens, attached to live coral (*Corallium* sp.). — Stn DW 101, 270 m: 2 specimens, attached to live coral (*Corallium* sp.).

BATHUS 3: stn CP 805, 278-310 m: 3 specimens, attached to coral (WAM 255-96). — Stn DW 830, 361-365 m: 4 specimens, attached to coral. (MNHN-Ci 2699). Drawn.

TYPES. — *Holotype*: MNHN-Ci 2403 (SMIB 5, stn DW 93).

Source : MNHN, Paris

Paratypes: BMNH (SMIB 5, stn DW 93). — MNHN-Ci 2404 (SMIB 5, stn DW 71). — MNHN-Ci 2699 (BATHUS 3, stn DW 830). Drawn. — USNM (SMIB 5, stn DW 93). — WAM 255-96 (BATHUS 3, stn DE 830).

DIAGNOSIS. —Rostral plate sutures obscure. CL^1 and CL^2 partially united; basal width of CL^2 9/10 basal width of CL^1; height of CL^2 8/9 height of CL^1. S elongated, pyramidal shape; externally convoluted growth ridges cut with many faint longitudinal striations. T with 10-14 muscle attachment ridges barely extending beyond basal margin. Caudal appendages longer than pedicel of cirrus VI by 1/4, 13 segments.

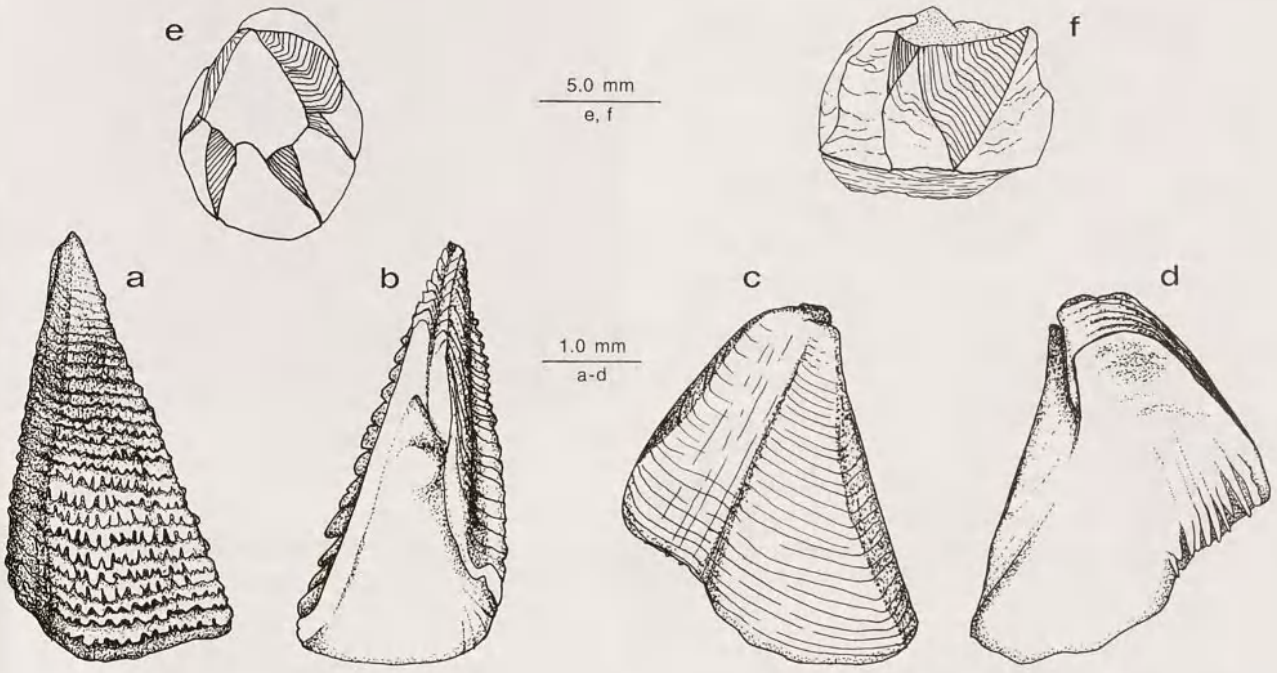

FIG. 36. — *Eurylasma pyramidale* sp. nov. Paratype from BATHUS 3, stn DW 830 (MNHN-Ci 2699): **a**, S, external view; **b**, S, internal view; **c**, T, external view; **d**, T, internal view; **e**, whole animal, from above (S and T removed); **f**, whole animal, lateral view.

DESCRIPTION. — Size large (maximum: RC length 14.1, C height 6.7). Form rounded, all parietes except C curving in toward orifice. Parietal plates rough textured; growth ridges regular, not deeply marked. Rostral plate with sutures obscure; basal width less than basal width of C, slightly greater than basal width of CL^1; apex curved in toward orifice; height subequal to height of C. CL^1 and CL^2 united, CL^2 still retaining small ala, suture lines visible externally. Basal width of CL^1 slightly less than basal width of rostral plate; apex curving toward orifice. Height of CL^2 8/9 height of CL^1, basal width of CL^2 9/10 basal width of CL^1 ; apex curving toward C. C widest of all plates, slightly higher than R, bowed, apex slightly curved inward, not spout-like. Basis calcareous, cup-shaped. Orifice triangular from above; not toothed. Opercular plates set parallel to basis, slightly sunken down in orifice, making gently concave depression due to concave form of scuta. S elongate, basal margin 5/12 length of occludent margin; pyramidal shape, produced by almost 90° bend toward articular margin on basal margin, bend at 3/4 length of basal margin from occludent margin; valve concave in upper 1/2 with upper 1/4 retroverted away from concavity; externally with convoluted growth ridges, cut by many longitudinal striations, giving almost beaded appearance; apex pointed; internally muscle scar visible at 2/3 height of valve; small lateral depressor muscle crests present; articular furrow wide; articular ridge barely projecting beyond articular margin; adductor ridge indistinct. T larger than S, triangular; externally with well-marked growth ridges; internally with 10-14 muscle crests barely extending beyond basal margin; articular ridge short, not projecting beyond articular margin; articular furrow wide; short spur set at basi-scutal angle, rounded, width 2/3 basal margin. Parietes of bleached specimens

Source : MNHN, Paris

pearly white with hint of shell pink, covered by pearly white, moderately thick membrane; specimens from live *Corallium* sp. with parietes, opercular plates and covering membrane yellowish-cream, sometimes C orange-yellow. Measurements of largest specimen examined as follows:

RC length	LD	C height	R height
14.1	9.6	6.7	6.1

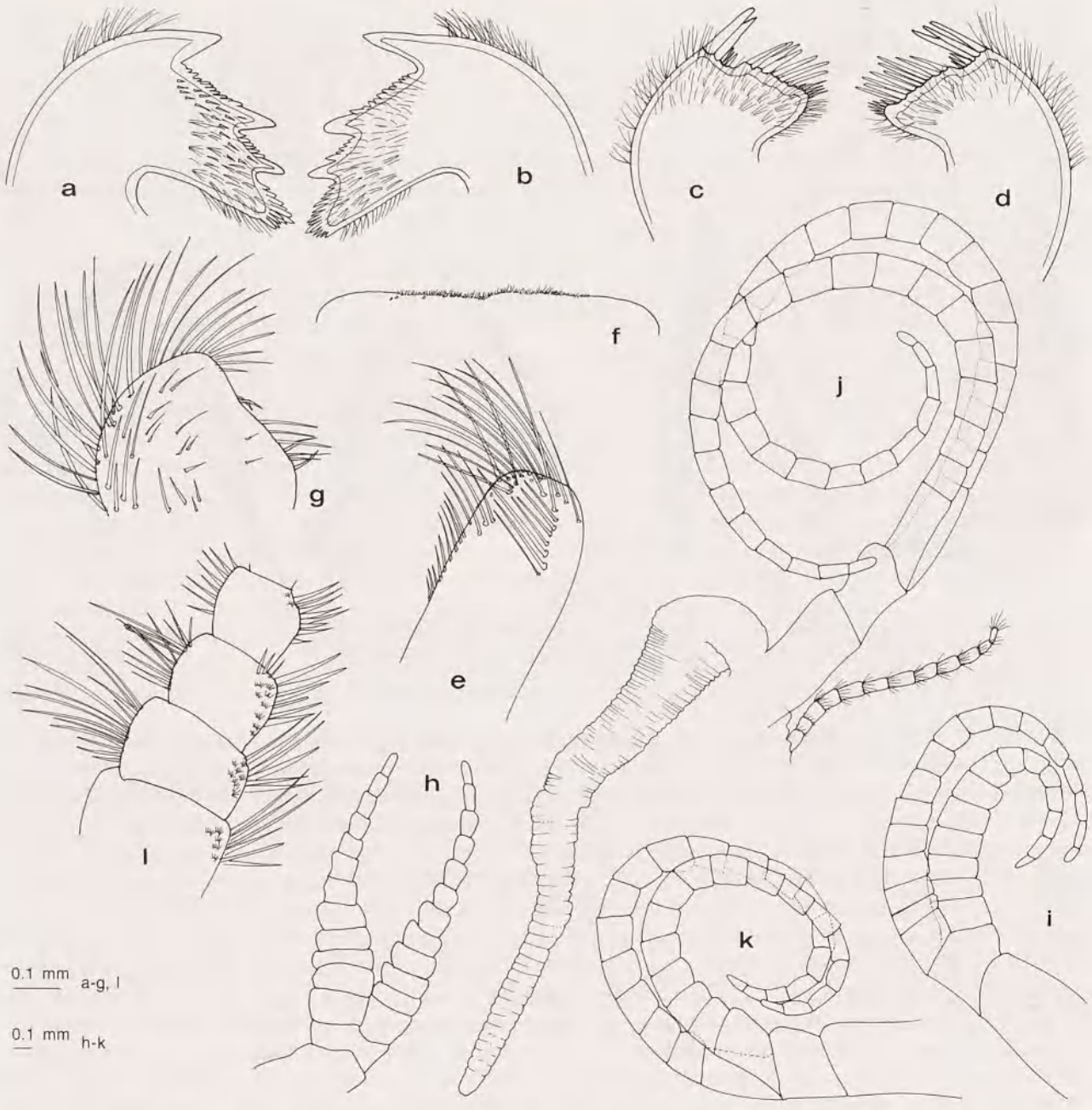

FIG. 37. — *Eurylasma pyramidale* sp. nov. Paratype from BATHUS 3, stn DW 830 (MNHN-Ci 2699): **a**, right mandible; **b**, left mandible; **c**, right maxillule; **d**, left maxillule; **e**, mandibular palp; **f**, labrum; **g**, maxilla; **h**, cirrus I; **i**, cirrus II; **j**, cirrus VI, penis and caudal appendage; **k**, cirrus III; **l**, cirrus I, posterior ramus, median segments.

Source : MNHN, Paris

Labrum with shallow medial depression; few scattered, small teeth present. Mandibular palp oblong; dense, serrate setae terminally. Mandible with 3 teeth, tooth 1 largest and well-separated from 2 and 3; upper margin of 2 and 3 strongly dentate; inferior angle moderately large, bluntly molariform, dentate. Maxillule with 1-2 pairs of long, stout setae at upper angle; notch below upper angle moderately wide, with 3-4 pairs of smaller setae; long cutting margin below with 7-10 pairs of larger setae; inferior angle small, with 4-6 pairs of smaller setae. Maxilla wide, coxal endite barely discernible; long serrulate setae terminally.

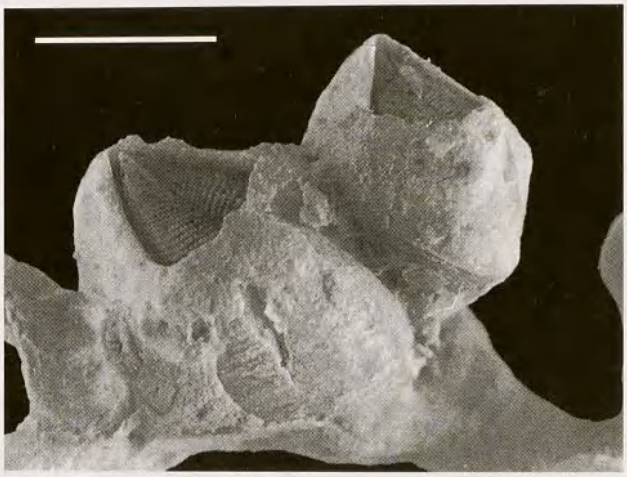

FIG. 38. — *Eurylasma pyramidale* sp. nov. Paratypes from BATHUS 3, stn DW 830 (WAM 255-96): lateral view. Scale = 5 mm.

Cirrus I with rami subequal; anterior ramus slightly longer than posterior; proximal segments of anterior and posterior rami protuberant anteriorly; both rami with segments moderately setose, setae finely serrulate distally; distal segments of posterior ramus with dense, stout setae at antero-distal angles and anterior surface with combs of small setae. Cirrus II longer than cirrus I; rami subequal; proximal segments of anterior ramus protuberant anteriorly; anterior and posterior rami antenniform distally; all segments setose, setae simple or serrulate. Cirrus III longer than but similar to cirrus II, with rami subequal, segments becoming oblong distally; posterior ramus with 2-5 pairs of long, finely serrulate setae on anterior faces of distal segments; anterior ramus with 2-5 pairs of long, finely serrulate setae on anterior faces of distal segments, proximal segments with 9 pairs. Cirrus IV to VI similar, longer than cirrus III; segments oblong, with 4-5 pairs of setae on anterior faces, distal 2 pairs of setae longest, finely serrulate. Chaetotaxy ctenopod. Cirral formula as follows:

Paratype:		C I	C II	C III	C IV	C V	C VI	c. a.
MNHN-	left	12, 12	13, 15	17, 18	22, 22	23, 25	23, 24	11
Ci 2699	right	12, 13	14, 17	17, 19	23, 26	26, 25	22, 26	12

Caudal appendages slightly longer than pedicel of cirrus VI; 13 segmented; long setae apically, circlets of short setae around distal margins of segments. Penis almost as long as cirrus VI; annulated; sparsely setose with circlet of long setae distally.

REMARKS. — Differences between *E. pyramidale* and *E. angustum* sp. nov. are listed under *E. angustum* and between *E. pyramidale* and *E. ferulum* sp. nov. are listed under *E. ferulum.*

ETYMOLOGY. — From the Greek *pyramidalis*, 'of a pyramidal shape', relating to the pyramidal form of the scuta.

DISTRIBUTION. — Norfolk Ridge, 255-365 m.

Genus ***TETRAPACHYLASMA*** Foster, 1988 (emend.)

Fig. 39; Tables 3-4, 15-17

Tetrapachylasma Foster, 1988: 226.

DIAGNOSIS. — Adult with variable wall pattern of 6-plates (R-CL^1-CL^2-C), or 4-plates (R-CL-C); in 6-plated wall, RL coalesces with R to form compound rostrum (RL+R+RL); in 4-plated wall RL and R form compound

Source : MNHN, Paris

rostrum and CL^2 coalesces with CL^1 to form compound CL plate. Rostral plate sutures obscure; basal width of R equal to basal width of RL. CL^1 and CL^2 separate, partially coalesced, or totally concrescent. S with growth lines cut by longitudinal striae. Caudal appendages varying from short (1/8 height of basal segment of pedicel of cirrus VI) to long (approximately twice height of pedicel of cirrus VI).

TYPE SPECIES. — *Tetrapachylasma trigonum* Foster, 1988.

RECENT SPECIES. — *Tetrapachylasma arcuatum* sp. nov.; *T. aurantiacum* (Darwin, 1854); *T. ferrugomaculosa* (Jones, 1993b); *T. ornatum* sp. nov.; *T. trigonum* Foster, 1988.

REMARKS. — FOSTER's (1988) diagnosis of *Tetrapachylasma* defined the genus as having "...Four (adult) solid calcareous compartmental plates including a carina, a rostrum and paired laterals ...". However, new material and re-examination of *P. aurantiacum* Darwin, 1854 and *P. ferrugomaculosa* Jones, 1993 (all attributed to *Tetrapachylasma* herein) confirm that the number of wall plates in the adults of these species is variable. The adult may have a 4-plated pattern, consisting of a compound rostral plate, a pair of plates formed by the coalescence of CL^1 and CL^2, and a C. However, within the same sample, 6-plated individuals of the same species also occur, where CL^1 and CL^2 are either separate or partially coalesced (but in the latter condition CL^2 still retains a minute ala). In these individuals the rostral sutures may be obscure or visible. I consider that FOSTER's (1988) diagnosis of *Tetrapachylasma* applies to the 4-plated adult condition found in the above samples and I have broadened the diagnosis of *Tetrapachylasma* accordingly, to embrace the variable plate numbers also found in the above samples. The variable 4- or 6-plated pattern, however, makes specific identification and attribution difficult when dealing with a single or few specimens. *Tetrapachylasma trigonum* may represent a condition where the 4-plated pattern has become fixed - the small number of specimens (3) in FOSTER's sample of *T. trigonum* is not significant to determine intra-specific variation within this species.

In *Tetrapachylasma*, RL coalesces with R to form a compound rostrum (RL+R+RL) in both the 6- and 4-plated wall forms. RL is not incorporated into the sheath, with the exception of *T. ornatum* sp. nov., where RL is clearly incorporated into the sheath (contrary to the definition of the Pachylasmatoidea). Thus in *Tetrapachylasma*, as re-defined, the adult wall condition (6- or 4-plated) is achieved through a reduction in the number of plates by coalescence, rather than by exclusion as was postulated by FOSTER (1988). The pattern of coalescence of the plates has not become fixed, at least within *T. arcuatum* sp. nov., *T. aurantiacum, T. ferrugomaculosa* and *T. ornatum* sp. nov., and the plates are disposed symmetrically rather than asymmetrically, since both the 4- and the 6-plated condition occur within the same species and no instances have been found of a 5-plated condition (i.e. CL^1 and CL^2 totally coalesced on one side only). Thus the adult condition for this genus is considered to be a variable wall pattern of either 4 or 6 parietal plates.

Such intra-specific variation is also seen in the Balanomorpha. Within the Chthamaloidea *Jehlius gilmorei* Ross, 1971, an unusual species from San Ambrosia and San Felix Islands, Chile, exhibits an array of wallpatterns in the adult condition (ROSS, 1971). In *Jehlius*, development of the adults is in a transitional stage between 6 and 4 plates, with reduction in the number of plates by coalescence rather than by exclusion. In the 4-plated stage the wall plates are not secondarily coalesced, the plates are disposed symmetrically or asymmetrically and the coalescence pattern is variable throughout the population. It appears, from the few specimens known of this species, that the pattern of coalescence of the plates has not become fixed. In the 4-plated *Tetrachthamalus*, however, a different pattern is seen. Here RL are coalesced with R and, during the ontogeny of individuals, the 4 plates coalesce.

DARWIN's (1854) diagnosis of *Pachylasma* defines the adult condition as 6- or 4-plated viz. " ....when mature, either six, or in appearance only four owing to the close union of the lateral compartments...". There is an implicit assumption in DARWIN's diagnosis that it applies to the fixed plate number in the adult condition (i.e. it refers to inter-specific variation). DARWIN's diagnosis was based on 2 species - *P. giganteum* (adult condition recognised as fixed 6-plated in the present paper) and *P. aurantiacum* (adult condition recognised as variable 4- or 6-plated in the present paper). The fixed 6-plated adult condition is herein recognised for *Pachylasma* (type species *P. giganteum*) and the variable 4- or 6-plated adult condition is herein recognised for *Tetrapachylasma* (type species *T. trigonum*).

Source : MNHN, Paris

TABLES 15 and 16. — *Tetrapachylasma*: characters of the species

	no. plates		R: RL	CL^1: CL^2	T	basis
	ext.	int.				
T. arcuatum sp. nov.	6 4	8 6	basal width R = basal width RL	separate, partially coalesced with CL^2 retaining minute ala, or totally coalesced; basal width CL^2 = to basal width CL^1; height CL^2 sub = height CL^1	artic. ridge slightly proj.; spur indistinct, 3/7 width basal margin; set 1/12 length basal margin from b-s angle; 12-16 muscle ridges proj. beyond basal margin; artic. margin with growth ridges raised to form elevated ridge	calcareous, sometimes centrally membranous
T. aurantiacum (Darwin, 1854)	6 4 4	8 6 4	basal width R = basal width RL	coalesced; basal width CL^2 = basal width CL^1	artic. ridge slightly proj.; spur indistinct, 3/7 width basal margin; set 1/12 length basal margin from b-s angle; 12-16 muscle ridges proj. beyond basal margin; artic. margin with growth ridges raised to form elevated ridge	calcareous
T. ferrugomaculosa (Jones, 1993)	6 4 4	8 6 4	basal width R = 2 x basal width RL	partially coalesced with CL^2 retaining ala; or coalesced; basal width CL^2 = 1/2 basal width CL^1	artic. ridge not proj.; spur indistinct, 1/2 width basal margin, set 1/12 length basal margin from b-s angle; 7-9 muscle ridges proj. beyond basal margin; artic. margin with growth ridges raised to form elevated ridge	calcareous edges, centrally membranous
T. ornatum sp. nov.	6 4 4	8 6 4	basal width R = basal width RL	basal width CL2 = slightly < basal width CL^1	artic. ridge proj.; spur1/3 width basal margin; set 1/12 length basal margin from b-s angle; 8-12 muscle ridges projecting beyond basal margin; artic. margin with growth ridges raised to form elevated ridge	calcareous (inferred)
T. trigonum Foster, 1988	4	4	n.a.	totally coalesced	artic. ridge proj.; spur broad, 1/3 width basal margin, set 1/7 length basal margin from b-s angle; basal corner of articular margin hollowed for reception of dwarf males; 6 muscle ridges proj. beyond basal margin; artic. margin with growth ridges raised to form elevated ridge	calcareous

artic. = articular; b-s = basi-scutal; ext. = external; int. = internal; n.a. = not applicable; proj. = projecting.

	S shape	S growth lines	c.a.	mandible
T. arcuatum sp. nov.	S basal margin 2/3 length of occludent margin; S artic. ridge proj.; occludent margin convex	sinuous; cut by 7-8 slight long. striae	16-18 segs; 2 x length of pedicel of CVI	tridentate; upper margins of teeth 2 and 3 with subsidiary cusps
T. aurantiacum (Darwin, 1854)	S width < 1/2 S length; basal margin 1/2 length of occludent margin; artic. ridge not proj.; occludent margin not convex	extremely convoluted; cut by 5-6 slight long. striae	5 segs; = 1/5 height of pedicel of CVI	tridentate; margins of teeth 2 and 3 with small subsidiary cusps
T. ferrugomaculosa (Jones, 1993)	S basal margin 7/10 length of occludent margin; S artic. ridge barely proj.; occludent margin not convex	very convoluted; cut by 6-8 long. striae	7-9 segs; = height of basal segment of pedicel of CVI	tridentate; small subsidiary cusps in angle between teeth 1 and 2; upper margins of teeth 2 and 3 with strong subsidiary cusps
T. ornatum sp. nov.	S basal margin 1/2 length of occludent margin; artic. ridge not proj.; occludent margin not convex	complexly sculptured; cut by 4-6 deep, long. striae	unknown	unknown
T. trigonum Foster, 1988	S basal margin > 5/8 length of occludent margin; artic. ridge not proj.; occludent margin not convex	ruffled, overlapping; not cut by long. striae	1 seg.; = 1/8 height of basal segment of pedicel of CVI	tridentate; upper margins of teeth 2 and 3 with small subsidiary cusps

artic. = articular; c.a. = caudal appendage; long. = longitudinal; max. = maximum; proj. = projecting; segs = segments.

Source : MNHN, Paris

DISTRIBUTION. — Southwestern and eastern Australia, Western and Central Pacific Ocean: Western Australia, 3-30 m (*T. ferrugomaculosa*); eastern Australia, Kermadec Islands, 122-490 m (*T. aurantiacum*); Vanuatu, Chesterfield Islands, Loyalty Islands, Loyalty Ridge, Norfolk Ridge, 226-1220 m (*T. arcuatum*); Marianas Islands, 6 m (*T. ornatum* sp. nov.); Cook Islands, 15 m (*T. trigonum*).

TABLE 17. — *Tetrapachylasma*: maximum size, geographical and bathymetrical distribution of the species

	size (max.)	distribution	depth
T. arcuatum sp. nov.	RC length 11.4; C height 9.5	Chesterfield Islands New Caledonia Loyalty Islands Loyalty Ridge Norfolk Ridge Vanuatu	385-610 m 255-610 m 300-460 m 400 m 226-1220 m 400-440 m
T. aurantiacum (Darwin, 1854)	RC length 24.0; C height 7.0	Eastern Australia, Kermadec Is	122-490 m
T. ferrugomaculosa (Jones, 1993)	RC length 11.4; C height 10.2	Western Australia	3-30 m
***T. ornatum* sp. nov.**	RC length 6.0, C height 2.5	Marianas Islands	6 m
T. trigonum Foster, 1988	RC length 10.0; C height 8.0	Cook Islands	15 m

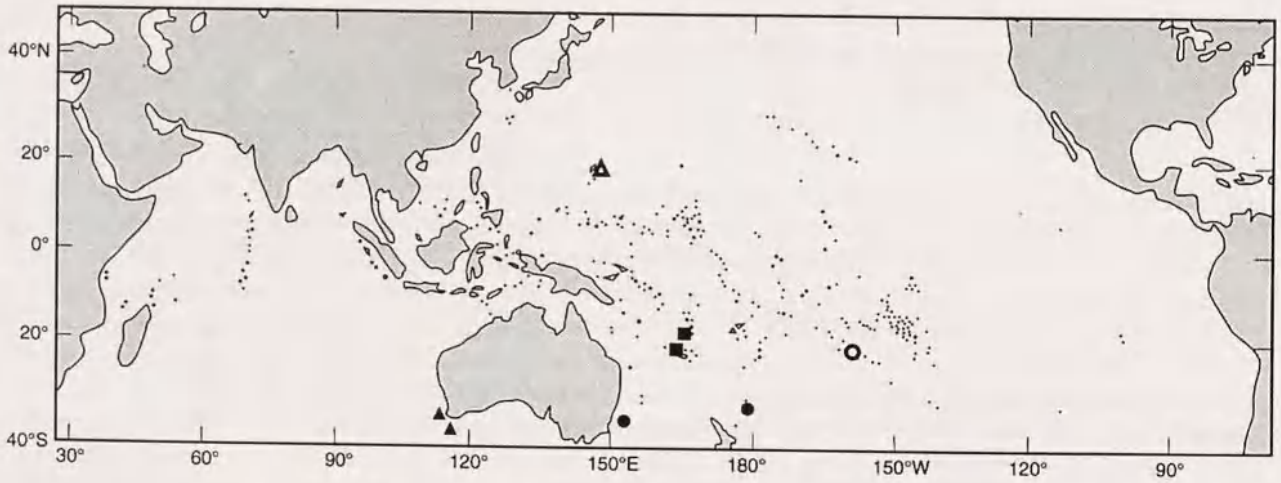

FIG. 39. — *Tetrapachylasma*. Distribution map: △, *T. ornatum* (6 m); ■, *T. arcuatum* (226-1220 m); ●, *T. aurantiacum* (122-490 m); ▲, *T. ferrugomaculosa* (3-30 m); ○, *T. trigonum* (15 m).

Tetrapachylasma arcuatum sp. nov.

Figs 39-42; Tables 15-17

MATERIAL EXAMINED. — **Chesterfield Islands**. MUSORSTOM 5: stn DW 255, 280-295 m: 2 specimens (MNHN-Ci 2407); 3 specimens, attached to coral. — Stn DW 301, 487-610 m: 5 specimens (2 juveniles), attached to sponge. — Stn DW 304, 385-420 m: 3 specimens.

Loyalty Islands. MUSORSTOM 6: stn DW 407, 360 m: 1 specimen. — Stn CP 471, 460 m: 1 specimen, attached to coral. — Stn CP 471, 460 m: 1 specimen, attached to coral (BMNH). — Stn DW 472, 300 m: 1 specimen, attached to sponge (MNHN-Ci 2406); several specimens, attached to sponge; 1 specimen, attached to dead stylasterid coral; 1 specimen, attached to a stone. — Stn DW 478, 400 m: 1 ovigerous specimen (broken), large orange eggs, attached to dead coral (MNHN-Ci 2700). Drawn; several specimens.

Loyalty Ridge. MUSORSTOM 6: stn DW 478, 400 m: 1 specimen, attached to 1 specimen of *Hexelasma persicum* sp. nov. (MNHN); 1 specimen (WAM 256-96); 1 specimen (WAM C 23251).

Vanuatu. MUSORSTOM 8: stn CP 963, 400-440 m: several specimens, attached to sponge.

New Hebrides Arc. VOLSMAR: stn DW 16, 500m: 1 specimen.

Source : MNHN, Paris

Norfolk Ridge. CHALCAL 2: stn CH 4, 253 m: 1 specimen, attached to sponge.
SMIB 5: stn DW 87, 370 m: 1 specimen, attached to coral rubble (USNM). — Stn DW 93, 255 m: many specimens.
HALIPRO 2: stn BT 70, 226-238 m: 1 specimen, attached to gorgonian. — Stn BT 71, 820-1220 m: 2 specimens, attached to gorgonian.

TYPES. — *Holotype*: MNHN-Ci 2406 (MUSORSTOM 6, stn DW 472).
Paratypes: BMNH (MUSORSTOM 6, stn CP 471). — MNHN-Ci 2407 (MUSORSTOM 5, stn DW 255). — MNHN-Ci 2700 (MUSORSTOM 6, stn DW 478). Drawn. — USNM (SMIB 5, stn DW 87). — WAM 256-96 (MUSORSTOM 6, stn DW 478).

DIAGNOSIS. — Rostral plate sutures visible; basal width of R equal to basal width of RL. CL^1 and CL^2 separate, partially or totally coalesced; basal width of CL^2 equal to basal width of CL^1. Articular margin of S curved toward occludent margin in upper 1/3; externally sinuous growth lines cut by 7-8 slight longitudinal striae; articular ridge projecting. T articular ridge slightly projecting; 12-16 muscle attachment ridges projecting beyond basal margin. Caudal appendages twice length of pedicel of cirrus VI; 16-18 segments.

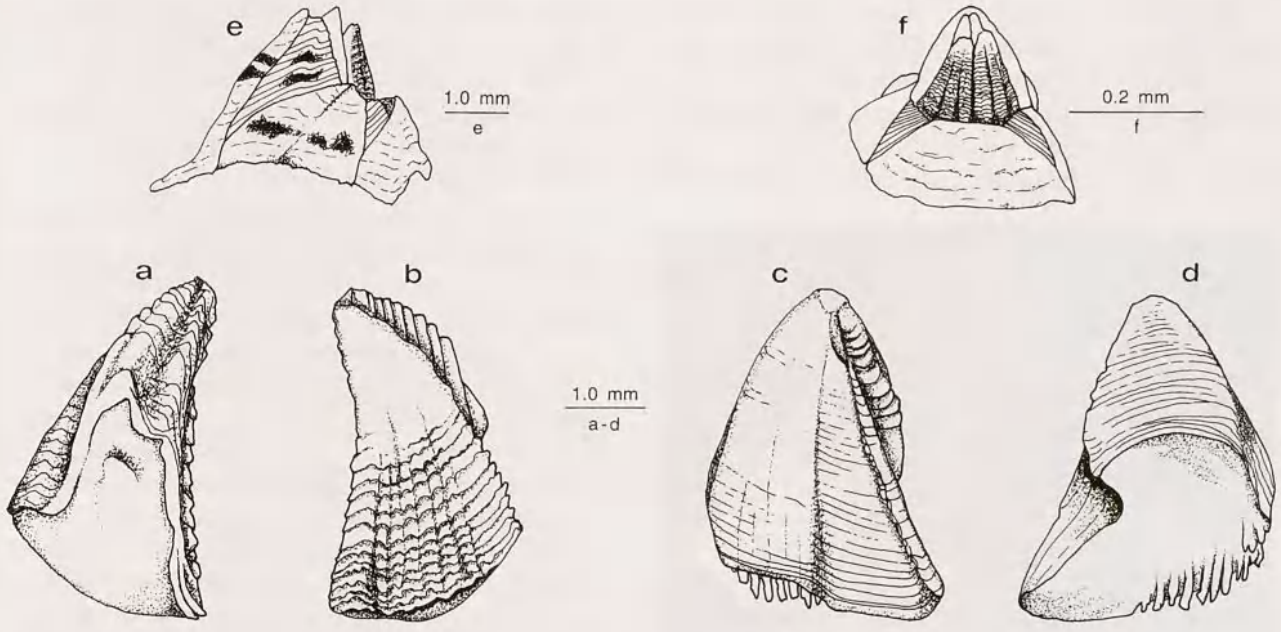

FIG 40. — *Tetrapachylasma arcuatum* sp. nov. Paratype from MUSORSTOM 6, stn DW 478 (MNHN-Ci 2700): **a**, S, internal view; **b**, S, external view; **c**, T, external view; **d**, T, internal view; **e**, whole animal, lateral view; **f**, whole animal, rostral view.

DESCRIPTION. — Size moderate (maximum: RC length 11.4, C height 9.5). Shell form upright, all parietal plates except C gently sloping in toward orifice; C sloping toward orifice at acute angle. Parietal plates solid, growth ridges irregular, not marked by small setae. Rostral plate broad, slightly convex, basal width twice basal width of C; sutures between R and RL visible internally, partially visible or obscure externally; basal width of R equal to basal width of RL. CL^1 and CL^2 separate in juveniles, partially or totally coalesced in mature specimens; basal width of CL^1 equal to basal width of CL^2, height of CL^2 subequal to height of CL^1; external suture sometimes indistinct, giving superficial impression of 1 plate, coalescence of plates incomplete with CL^2 retaining minute ala, latter obscure in adults if plates apically eroded; ala of CL^1 1/4 width of carinal ala, ala of CL^2 minute, 1/6 width of alae of CL^1. C alae widest; C highest of all plates, almost twice height of R, basal width 1/2 basal width of R. Basis thin, flat; calcareous, centrally thin, sometimes membranous. Orifice large, subtriangular, not toothed. Basis thin, flat; calcareous, centrally thin, sometimes membranous. Opercular plates lodged upright in orifice; C seemingly forming hood over opercular plates. S smaller than T; triangular, elongated,

Source : MNHN, Paris

convex basal margin 2/3 length of occludent margin; articular margin distinctly curved toward occludent margin in upper 1/3; externally growth ridges sinuous, cut with 7-8 radial striations; apex blunt; internally adductor muscle pit deep, situated 2/3 up length of valve; lateral depressor muscle pit indistinct; articular furrow narrow; articular ridge 1/2 length of valve, projecting beyond articular margin; adductor ridge indistinct. T triangular, wider than S; externally growth ridges well marked, articular margin with growth ridges raised to form elevated ridge; internally with 12-16 strong muscle attachment crests projecting well beyond basal margin; articular ridge short, prominent, projecting slightly beyond articular margin; articular furrow broad; spur set at 1/12 length of basal margin from basi-scutal angle, truncate, 3/7 width of basal margin, barely defined from basal margin. Color of parietal plates dirty cream with orange-brown markings on C and carinal alae. Eggs orange. Measurements of 6 specimens examined, randomly selected from several stations, as follows:

	RC length	LD	C height	R height
rg	6.9-11.4	5.6-11.3	5.5-9.5	3.3-5.7
$\bar{x}$	9.5	8.8	7.8	4.8

Labrum with shallow medial depression, with regular row of small bi- or tri-lobed teeth. Mandibular palp ovoid; long serrate setae terminally. Mandible with 3 teeth, tooth 1 largest, well separated from teeth 2 and 3; upper margins of 2 and 3 teeth with small subsidiary cusps; inferior angle bluntly molariform, dentate. Maxillule setose; 2-3 long, stout setae at upper angle; indistinct notch below upper angle with 23 pairs of smaller setae; cutting margin below stepped, with 5-6 pairs of longer, stout setae; inferior angle stepped, with 5-6 pairs of smaller setae. Maxilla wide; coxal endite not well developed; dense, long setae terminally.

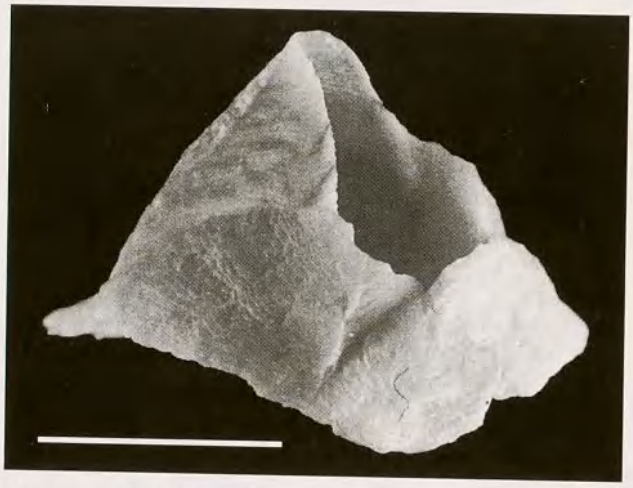

FIG. 41. — *Tetrapachylasma arcuatum* sp. nov. Holotype from MUSORSTOM 6, stn DW 472 (MNHN-Ci 2406): lateral view. Scale = 5 mm.

Cirrus I with rami unequal; anterior ramus longer than posterior; proximal segments of anterior ramus protuberant anteriorly; both rami with segments thickly setose, setae strong, serrulate, stout; postero-distal angles of segments of posterior ramus with tufts of stout, serrate setae, surface with combs of small setae. Cirrus II similar to but slightly longer than cirrus I; rami subequal; proximal segments of anterior ramus broad, slightly protuberant anteriorly, all segments thickly setose, setae simple, stout; posterior ramus more antenniform than anterior, segments becoming more elongated and narrower distally, distal segments with 3-4 pairs of long, finely serrulate setae on anterior faces. Cirrus III similar to cirri IV-VI; rami subequal, segments becoming oblong distally; posterior ramus with 2-4 pairs of long, finely serrulate setae on anterior faces of distal segments; anterior ramus with 2-3 pairs of long, finely serrulate setae on anterior faces of distal segments, proximal segments with 6 pairs. Cirrus IV to VI similar, longer than cirrus III; segments oblong, with 4 pairs of setae on anterior faces, distal 2 pairs longest. Chaetotaxy ctenopod. Cirral formula as follows:

Paratype:		C I	C II	C III	C IV	C V	C VI	c. a.
MNHN-	left	10, 9	11, 13	18, 19	20, 22	24, 24	24, 25	16
Ci 2700	right	10, 9	12, 13	16, 19	21, 23	21, 24	24, 25	18

Caudal appendages twice length of pedicel of cirrus VI; 16-18 segmented; long setae apically and around distal segmental margins. Penis slightly shorter than length of cirrus VI; annulated; sparsely setose; circlet of long setae distally. Eggs large, rounded, 0.40 x 0.42 mm.

Source : MNHN, Paris

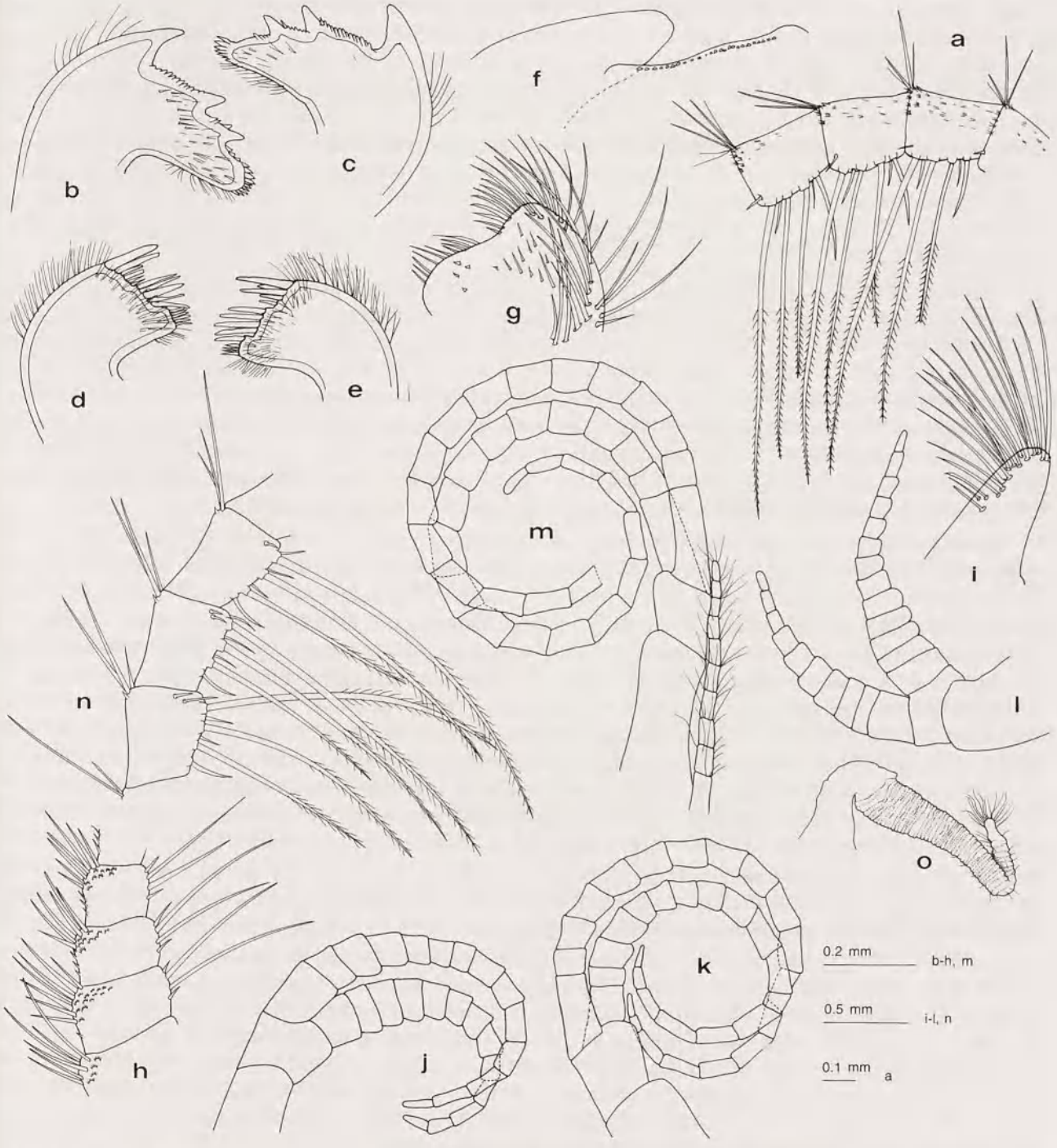

FIG. 42. — *Tetrapachylasma arcuatum* sp. nov. Paratype from MUSORSTOM 6, stn DW 478 (MNHN-Ci 2700): **a**, cirrus VI, posterior ramus, median segments; **b**, right mandible; **c**, left mandible; **d**, right maxillule; **e**, left maxillule; **f**, labrum; **g**, maxilla; **h**, cirrus I, posterior ramus, median segments; **i**, mandibular palp; **j**, cirrus II; **k**, cirrus III; **l**, cirrus I; **m**, cirrus VI and caudal appendage; **n**, cirrus III, posterior ramus, median segments; **o**, penis.

REMARKS. — *T. arcuatum* sp. nov. can be separated from *T. aurantiacum* as follows: the S articular margin is convex, the S basal margin is 2/3 the length of the occludent margin, the articular ridge is projecting and the scutal

Source : MNHN, Paris

growth ridges are sinuous and cut by 7-8 longitudinal striae in *T. arcuatum*. In *T. aurantiacum* the S articular margin is not convex, the S basal margin is 1/2 the length of the occludent margin, the articular ridge is not projecting and the scutal growth ridges are convoluted and cut by 5-6 slight longitudinal striae. The T articular ridge of *T. arcuatum* is slightly projecting, and the spur is indistinct, 3/7 the width of the basal margin and set at the basi-scutal angle, with 12-16 muscle crests projecting from the basal margin. In *T. aurantiacum* the T articular ridge is not projecting, and the spur is 1/2 the width of the basal margin and set at a distance of 1/10 the width of the basal margin from the basi-scutal angle, with 6-7 muscle crests projecting from the basal margin. The caudal appendages of *T. arcuatum* are 16-18 segmented and twice the height of the pedicel of cirrus VI; those of *T. aurantiacum* are 5 segmented and 1/5 the height of the pedicel of cirrus VI. *Tetrapachylasma arcuatum* is small in size (RC length 11.4, C height 9.5), whereas *T. aurantiacum* is significantly larger (RC length 24.0, C height 7.0).

T. arcuatum differs from *T. ornatum* sp. nov. as the S articular margin is curved, the S basal margin is 2/3 the length of the occludent margin, the articular ridge is projecting and the scutal growth ridges are sinuous, and cut by 7-8 longitudinal striae. In *T. ornatum* the S articular margin is not curved, the S basal margin is 1/2 the length of the occludent margin, the articular ridge is not projecting and the growth ridges are complexly sculptured, cut by 4-6 deep, longitudinal striae. The T articular ridge of *T. arcuatum* is slightly projecting, and the spur is indistinct, 3/7 the width of the basal margin and set at the basi-scutal angle, with 12-16 muscle crests projecting from the basal margin. In *T. ornatum* the T articular ridge is projecting, and the spur is short, more than 1/3 the width of the basal margin and set at a distance of 1/12 the width of the basal margin from the basi-scutal angle, with 8-12 muscle crests projecting from the basal margin. Soft parts of *T. ornatum* are unknown.

The long caudal appendages (approximately twice the length of the pedicel of cirrus VI) and the form of the paries (without narrow ribs) prevent confusion of *T. arcuatum* with *T. trigonum* (uniarticulate caudal appendages, 1/8 the height of the basal segment of the pedicel of cirrus VI; outer surface of paries with narrow ribs peripherally). The S articular margin is curved, the S basal margin is 2/3 the length of the occludent margin, the articular ridge is projecting and the scutal growth ridges are sinuous, and cut by 7-8 longitudinal striae in *T. arcuatum*. In *T. trigonum* the S basal margin is 5/8 the length of the occludent margin, the articular ridge is not projecting and the scutal growth ridges are ruffled and overlapping, and not cut by longitudinal striae. In *T. arcuatum* the T articular ridge is slightly projecting, and the spur is indistinct, 3/7 the width of the basal margin and set at the basi-scutal angle, with 12-16 muscle crests projecting from the basal margin. In *T. trigonum* the T articular ridge is projecting, and the spur is 1/3 the width of the basal margin and set at a distance of 1/7 the width of the basal margin from the basi-scutal angle, with 6 muscle crests slightly projecting from the basal margin, and the basal corner of the articular ridge is hollowed out for the reception of dwarf males.

The new species differs from *T. ferrugomaculosa* as the caudal appendages of the latter are 7-9 segmented and short (equal to the height of the basal segment of the pedicel of cirrus VI) rather than 16-18 segmented and long (approximately twice the height of the pedicel of cirrus VI). In *T. ferrugomaculosa* the S articular margin is not curved, the S basal margin is 7/10 the length of the occludent margin, the articular ridge is barely projecting and the scutal growth ridges are very convoluted, and cut by 6-8 longitudinal striae. In *T. arcuatum* the S articular margin is curved, the S basal margin is 2/3 the length of the occludent margin, the articular ridge is projecting and the scutal growth ridges are sinuous, and cut by 7-8 longitudinal striae. The T articular ridge of *T. ferrugomaculosa* is not projecting, the T spur is indistinct, 1/2 the width of the basal margin and set at a distance of 1/12 the width of the basal margin from the basi-scutal angle, with 7-9 muscle crests projecting well beyond the basal margin. In *T. arcuatum* the T articular ridge is slightly projecting, the T spur is indistinct, 3/7 the width of the basal margin and set at the basi-scutal angle, with 12-16 muscle crests projecting from the basal margin.

ETYMOLOGY. — From the Latin *arcuatus*, 'curved', in reference to the curved form of the articular margin of the S.

DISTRIBUTION. — Chesterfield Islands, 280-610 m; Loyalty Islands, 300-460 m; Loyalty Ridge, 400 m; Vanuatu, 400-440 m; New Hebrides Arc, 500 m; Norfolk Ridge, 226-1220 m.

Source : MNHN, Paris

Tetrapachylasma aurantiacum (Darwin, 1854), comb. nov.
Fig. 39; Tables 15-17

Pachylasma aurantiacum Darwin, 1854: 480, pl. 20 figs 1 a-d. — WELTNER, 1897: 273. — GRUVEL, 1905: 199, fig. 219. — NEWMAN & ROSS, 1976: 40. — FOSTER, 1981: 354, figs 2 E, 4 A-L.

TYPES. — *Holotype*: BMNH (no registration number) New South Wales, Australia, apparently from deep water, attached to sandstone; dry specimen.
Holotype depository: BMNH.

DIAGNOSIS. — R and RL closely united by linear sutures, latter often obliterated externally but visible internally; basal width R equal to basal width of RL. CL^1 and CL^2 closely united by linear sutures; basal width CL^2 equal to basal width CL^1. S articular ridge not projecting; growth lines extremely convoluted, cut by 5-6 slight longitudinal striae. T articular ridge not projecting; 6-7 muscle crests projecting from basal margin. Caudal appendages 5 segmented, 1/5 the height of pedicel of cirrus VI.

REMARKS. — The variable nature of the adult plate pattern has been noted previously for *Pachylasma aurantiacum* but the significance of the variability has not been recognised. DARWIN (1854) commented that '...the compartments in appearance are only four; but on close examination, the lateral compartments are seen to be divided by a very fine fissure into 2 equal compartments...' and FOSTER (1981), examining new collections of this species, noted '... carinolatus/latus or latus/rostral plate variously coalesced externally so that no intermediate alar areas show (although always with distinct sutures internally).' The variable plate pattern of adults of *P. aurantiacum* is recognised herein. Comparing shell plate, opercular plate and soft body morphology, this species is now included in the genus *Tetrapachylasma*.

Tetrapachylasma aurantiacum is a large species (maximum: RC length 24.0, C height [inferred] 7.0). Differences between *T. aurantiacum* and *T. arcuatum* sp. nov. are listed under *T. arcuatum*. In *T. ferrugomaculosa* the caudal appendages are 7-9 segmented and equal to the height of the basal segment of the pedicel of cirrus VI, rather than 5 segmented and 1/5 the height of the pedicel of cirrus VI (*T. aurantiacum*). In *T. ferrugomaculosa* the S basal margin is 7/10 the length of the occludent margin, the articular ridge is barely projecting and the scutal growth ridges are convoluted, and cut by 6-8 longitudinal striae. In *T. aurantiacum* the S basal margin is 1/2 the length of the occludent margin, the articular ridge is not projecting and the scutal growth ridges are convoluted and cut by 5-6 slight longitudinal striae. The T articular ridge of *T. ferrugomaculosa* is not projecting, the T spur is indistinct, 1/2 the width of the basal margin and set at a distance of 1/12 the width of the basal margin from the basi-scutal angle, with 7-9 muscle crests projecting well beyond the basal margin. In *T. aurantiacum* the T articular ridge is not projecting, and the spur is 1/2 the width of the basal margin and set at a distance of 1/10 the width of the basal margin from the basi-scutal angle, with 6-7 muscle crests projecting from the basal margin.

Characters of the T separate *T. aurantiacum* from *T. ornatum* sp. nov. The T articular ridge of *T. aurantiacum* is not projecting, and the spur is 1/2 the width of the basal margin and set at a distance of 1/10 the width of the basal margin from the basi-scutal angle, with 6-7 muscle crests projecting from the basal margin. In *T. ornatum* the T articular ridge is projecting, and the spur is indistinct, more than 1/3 the width of the basal margin and set at a distance of 1/12 the width of the basal margin from the basi-scutal angle, with 8-12 muscle crests projecting from the basal margin. In *T. aurantiacum* the S basal margin is 1/2 the length of the occludent margin, the articular ridge is not projecting and the scutal growth ridges are extremely convoluted and cut by 5-6 slight, longitudinal striae. In *T. ornatum* the S basal margin is 1/2 the length of the occludent margin, the articular ridge is not projecting and the growth ridges are complexly sculptured, cut by 4-6 deep, longitudinal striae. Soft parts of *T. ornatum* are unknown. *Tetrapachylasma ornatum* is small in size (RC length 6.0, C height 2.5), whereas *T. aurantiacum* is large (RC length 24.0, C height 7.0).

Tetrapachylasma aurantiacum can be separated from *T. trigonum* by the form of the caudal appendages (5 segmented, 1/5 the height of the pedicel of cirrus VI, and uniarticulate, 1/8 the height of the basal segment of the pedicel of cirrus VI, respectively). In *T. aurantiacum* the paries are without narrow ribs; in *T. trigonum*

Source : MNHN, Paris

the surface of the paries have narrow ribs peripherally. In *T. aurantiacum* the S basal margin is 1/2 the length of the occludent margin, the articular ridge is not projecting and the scutal growth ridges are extremely convoluted and cut by 5-6 slight, longitudinal striae. In *T. trigonum* the S basal margin is 5/8 the length of the occludent margin, the articular ridge is not projecting and the scutal growth ridges are ruffled and overlapping, and not cut by longitudinal striae. The T articular ridge of *T. aurantiacum* is not projecting, and the spur is 1/2 the width of the basal margin and set at a distance of 1/10 the width of the basal margin from the basi-scutal angle, with 6-7 muscle crests projecting from the basal margin. In *T. trigonum* the T articular ridge is projecting, and the spur is 1/3 the width of the basal margin and set at a distance of 1/7 the width of the basal margin from the basi-scutal angle, with 6 muscle crests slightly projecting from the basal margin, and the basal corner of the articular ridge hollowed out for the reception of dwarf males.

DISTRIBUTION. — New South Wales, Australia; Kermadec Is, New Zealand; 122-490 m.

Tetrapachylasma ferrugomaculosa (Jones, 1993), comb. nov.

Fig. 39; Tables 15-17

Pachylasma ferrugomaculosa Jones, 1993b: 116, fig. 1 a-o.

MATERIAL EXAMINED. — **South-western Australia (between Rottnest I. and Albany)**. Rottnest Island, 30 m: holotype (WAM 220-91). — Roe Reef, Rottnest Island, 30 m: paratype (WAM 223-91).

Other material: Duffield Ridge, Rottnest Island, 30 m (WAM 224-91). — Roe Reef, Rottnest Island, 30 m (WAM 225-91). — Salmon Bay, Rottnest Island (WAM 427-95). — Kwinana, 3-5 m (WAM 180-75). — Kwinana, 3-5 m (WAM 186-75). — Off Castle Rock, Dunsborough, 20 m (WAM 221-91). — From wreck off Dunsborough (WAM 464-92). — King George Sound, Albany (WAM 222-91).

TYPES. — *Holotype*: WAM 220-91; Western Australia; Duffield Ridge, Rottnest Island, 30 m.
Paratype: WAM 223-91; Western Australia; Roe Reef, Rottnest Island, 30 m.
Holotype and paratype depository: WAM.

DIAGNOSIS. — R and RL closely united by linear sutures, latter often obliterated externally but visible internally; basal width R twice basal width of RL. Basal width CL^2 1/2 basal width CL^2; plates separate, or partially or totally coalesced. S articular ridge barely projecting; growth lines convoluted, cut by 6-8 longitudinal striae. T articular ridge not projecting; 7-9 muscle crests projecting from basal margin. Caudal appendages 7-9 segmented, equal to height of basal segment of pedicel of cirrus VI.

REMARKS. — Re-examination of the type material as well as of new collections of specimens of *Pachylasma ferrugomaculosa* have revealed that the number of shell plates in the adult condition is variable within this species. The adult form may be 6-plated (rostral plate, CL^1 and CL^2 distinct entities or partially coalesced, and C) or 4-plated (rostral plate, CL^1 and CL^2 totally coalesced, and C). Comparing wall, opercular plate and soft body morphology, *T. arcuatum* sp. nov., *T. aurantiacum* (Darwin, 1854), *T. ornatum* sp. nov. and *T. trigonum* Foster, 1988 are closely related to *P. ferrugomaculosa* (*sensu* JONES, 1993b) and the latter is now included within *Tetrapachylasma*. JONES (1993b) noted the similarity between *P. ferrugomaculosa* and *P. aurantiacum*.

Tetrapachylasma ferrugomaculosa is a moderate sized species (maximum: RC length 11.4, C height 10.2). Differences between *T. ferrugomaculosa*, *T. arcuatum* sp. nov. and *T. aurantiacum* (Darwin, 1854) are listed under *T. arcuatum* and *T. aurantiacum*, respectively. Soft parts of *T. ornatum* are unknown; thus only hard parts can be compared with *T. ferrugomaculosa*. In *T. ornatum* the S basal margin is 1/2 the length of the occludent margin, the articular ridge is not projecting and the growth ridges are complexly sculptured, cut by 4 deep, longitudinal striae. In *T. ferrugomaculosa* the S basal margin is 7/10 the length of the occludent margin, the articular ridge is barely projecting and the convoluted scutal growth ridges are cut by 6-8 longitudinal striae. The T articular ridge of *T. ferrugomaculosa* is not projecting, the T spur is indistinct, 1/2 the width of the basal margin and set at a distance of 1/12 the width of the basal margin from the basi-scutal angle, with 7-9 muscle crests projecting well beyond the basal margin. In *T. ornatum* the T articular ridge is projecting, and the spur is short, more than 1/3

Source : MNHN, Paris

the width of the basal margin and set at a distance of 1/12 the width of the basal margin from the basi-scutal angle, with 8-12 muscle crests projecting from the basal margin. *Tetrapachylasma ornatum* is small in size (RC length 6.0, C height 2.5), whereas *T. aurantiacum* is larger (RC length 11.4, C height 10.2).

Tetrapachylasma ferrugomaculosa can be separated from *T. trigonum* by the form of the caudal appendages (7-9 segmented, equal to the height of the basal segment of the pedicel of cirrus VI, and uniarticulate, 1/8 the height of the basal segment of the pedicel of cirrus VI, respectively). The paries of *T. ferrugomaculosa* are without narrow ribs; in *T. trigonum* the surface of the paries have narrow ribs peripherally. In *T. ferrugomaculosa* the S basal margin is 7/10 the length of the occludent margin, the articular ridge is barely projecting and the scutal growth ridges are very convoluted, and cut by 6-8 longitudinal striae. The S basal margin of *T. trigonum* is 5/8 the length of the occludent margin, the articular ridge is not projecting and the scutal growth ridges are ruffled and overlapping, and not cut by longitudinal striae. The T articular ridge of *T. ferrugomaculosa* is not projecting, the T spur is indistinct, 1/2 the width of the basal margin and set at a distance of 1/12 the width of the basal margin from the basi-scutal angle, with 7-9 muscle crests projecting well beyond the basal margin. In *T. trigonum* the T articular ridge is projecting, and the spur is 1/3 the width of the basal margin and set at a distance of 1/7 the width of the basal margin from the basi-scutal angle, with 6 muscle crests slightly projecting from the basal margin, and the basal corner of the articular ridge is hollowed out for the reception of dwarf males.

DISTRIBUTION. — South-western Australia, 3-30 m.

Tetrapachylasma ornatum sp. nov.

Figs 39, 43-44; Tables 15-17

MATERIAL EXAMINED. — **Marianas Islands**. The Grotto, Puntan, Madog, Saipan, 6 m, 27.07.1969: 2 specimens attached to the sclerosponge *Astrosclera* sp. (YPM 9303 A, B); 1 specimen attached to the sclerosponge *Astrosclera* sp. (YPM 9305).

TYPES. — *Holotype*: YPM 9303 A (The Grotto, Puntan, Madog, Saipan, 6 m, 27.07.1969).

Paratypes: YPM 9303 B (The Grotto, Puntan, Madog, Saipan, 6 m, 27.07.1969). — YPM 9305 (The Grotto, Puntan, Madog, Saipan, 6 m, 27.07.1969).

DIAGNOSIS. — R and RL closely united by inconspicuous linear sutures; basal width of R equal to basal width of RL; RL clearly incorporated in the sheath. Basal width of CL^2 slightly less than basal width of CL^1; CL^1 and CL^2 partially or totally coalesced. S basal margin sinuous, externally growth ridges complexly sculptured, cut by 4-6 deep radial striations; articular ridge not projecting beyond articular margin. T articular ridge projecting; 8-12 strong muscle attachment ridges extending well beyond basal margin.

DESCRIPTION. — Size small (maximum: RC length 6.0, C height 2.5). Shell form low conical, higher at carinal end; almost circular when viewed from above. Parietal plates externally differentiated in adult as 6 plates - rostral plate, paired CL^1 and CL^2 (sometimes partialy coalesced) and C - or 4 plates (rostral plate, $CL^1$and CL^2 coalesced, C); plates solid, thicker basally, internally calcareous pegs developed along basal margins of paries; externally growth ridges ill-defined, irregularly scalloped, more regular and defined on rostral plate; outer surface of paries rough. Alae of C and CL^1 wide, triangular, well-developed; alae of CL^2 minute or absent; alar growth ridges widely spaced, parallel to inferior alar margin; superior alar margins serrate; alar welting absent. Rostral plate broad, convex, smaller than C; apex pointing inward; sutures between R and RL not or slightly visible externally and internally. In adults CL^1 and CL^2 coalesced (4-plated condition) or incompletely coalesced (6-plated condition); CL^1 triangular, slightly larger than CL^2; apices sloping inward, toward C. CL^2 triangular; apex sloping inward, toward C. C largest, highest plate, occupying almost 1/2 circumference of shell; apex pointed, V-shaped from above; plate sloping inward toward orifice; alae wide. Basis unknown, presence of calcareous pegs along basal margins of parietes indicative of interdigitation with calcareous basis. Orifice large, triangular, not toothed. S thick; elongate triangular; basal margin sinuous, 3/7 length of occludent margin; externally growth ridges complexly sculptured, cut by 4 deep radial striations; apex pointed; internally smooth, adductor muscle pit absent,

Source : MNHN, Paris

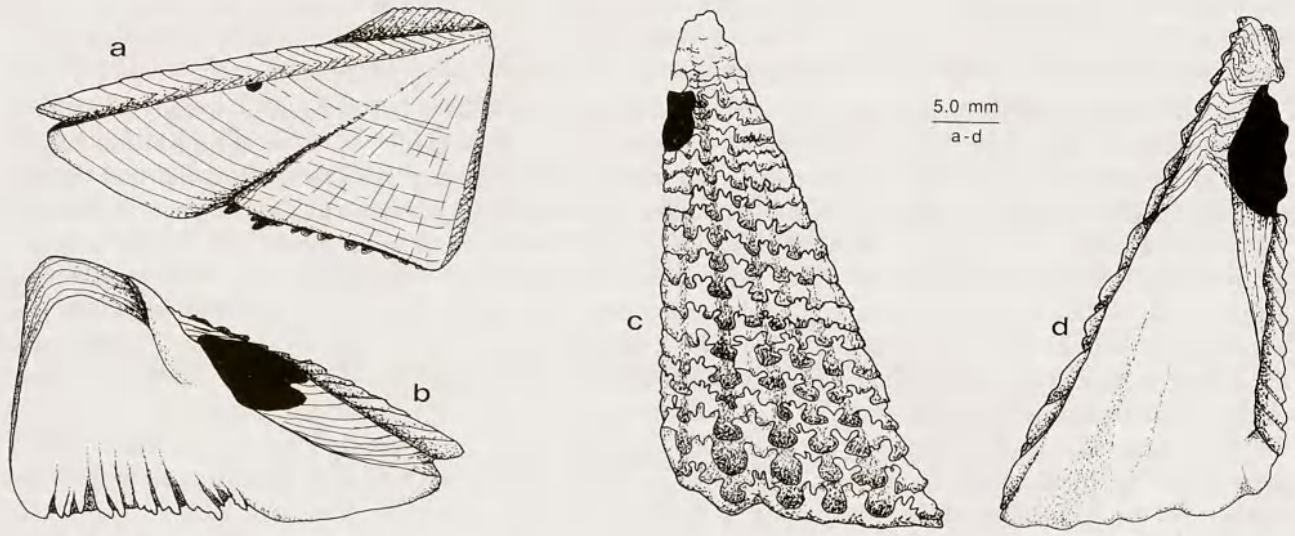

FIG. 43. — *Tetrapachylasma ornatum* sp. nov. Holotype from Puntan, Madog, Saipan (YPM 9303A): **a**, T, external view; **b**, T, internal view; **c**, S, external view; **d**, S, internal view.

depressor muscle pits indistinct; articular furrow broad, deep; articular ridge high, not projecting beyond articular margin; adductor ridge indistinct. T wider than S, triangular, basal margin twice height of valve; externally with regular growth ridges; internally with 8-12 strong muscle attachment ridges extending well beyond basal margin; articular ridge projecting beyond articular margin; articular margin with growth ridges raised to form elevated ridge; articular furrow broad, deep; spur furrow shallow, spur 1/3 width of basal margin, truncate, pointing toward and set a distance of 1/12 length of basal margin from basi-scutal angle. Color of parietal plates, alae and opercular plates buff with dull ochre/orange. Measurements (approximate) of holotype:

Holotype:	RC length	RC width	C height	R height
YPM 9303 A	6.0	6.0	2.5	2.1

Soft parts not known presently.

REMARKS. — During the course of the present study 3 dry specimens from the Marianas Islands were sent to me, for comparative purposes, by Professor W. NEWMAN. The cirripeds had been collected by T. GOREAU and J. LANG who had sent them, and the associated sclerosponge, to Willard HARTMAN of YPM for identification. The cirriped material is herein described as *Tetrapachylasma ornatum* sp. nov. On examination it is clear that the RL does enter the sheath, a unique attribute not found in any other tetrapachylasmatid or pachylasmatoid species presently known. Apart from this unique character, the complex S sculpturing separates *T. ornatum* from all other species in the genus and warrants specific status. Differences between *T. ornatum* sp. nov. and *T. arcuatum* sp. nov., *T aurantiacum* and *T. ferrugomaculosa* are listed under and *T. arcuatum* sp. nov., *T aurantiacum* and *T. ferrugomaculosa*, respectively. Details of the soft part anatomy of *T. ornatum* are presently unknown.

Tetrapachylasma ornatum differs from *T. trigonum* in the form of the parietal plates (narrow peripheral ribs present in *T. trigonum*, absent in *T. ornatum*). The S basal margin of *T. trigonum* is 5/8 the length of the occludent margin, the articular ridge is not projecting and the scutal growth ridges are ruffled and overlapping, and not cut by longitudinal striae. In *T. ornatum* the S basal margin is 1/2 the length of the occludent margin, the articular ridge is not projecting and the complexly sculptured scutal growth ridges are cut by 4-6 deep, longitudinal striae. The T articular ridge of *T. ornatum* is projecting; the spur is indistinct, more than 1/3 the width of the basal margin and set at a distance of 1/12 the width of the basal margin from the basi-scutal angle; and there are 8-12 muscle crests projecting from the basal margin. In *T. trigonum* the T articular ridge is projecting; the spur is

Source : MNHN, Paris

1/3 the width of the basal margin and set at a distance of 1/7 the width of the basal margin from the basi-scutal angle; and there are 6 muscle crests slightly projecting from the basal margin. Additionally, the basal corner of the articular ridge is hollowed out for the reception of dwarf males in *T. trigonum*. *Tetrapachylasma ornatum* is small in size (RC length 6.0, C height 2.5), *T. aurantiacum* is larger (RC length 10.0, C height 8.0).

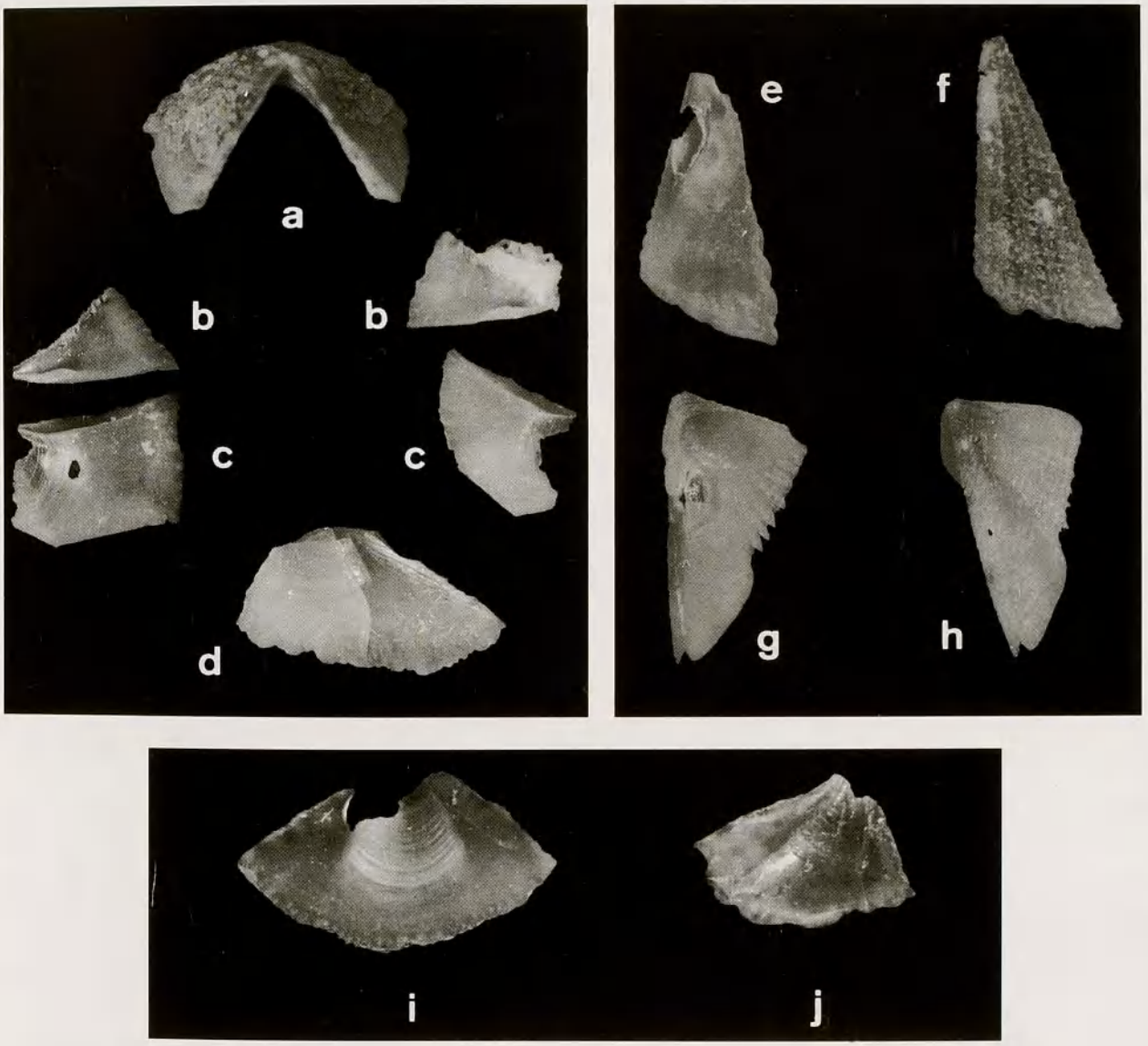

FIG. 44. — *Tetrapachylasma ornatum* sp. nov.

a-d. — Paratype from Puntan, Madog, Saipan (YPM 9305). Wall plates: **a**, C from above; **b**, CL^2, internal view; **c**, CL^1 internal view; **d**, R+RL+ missing RL, internal view.

e-i. — Holotype from Puntan, Madog, Saipan (YPM 9303A). **e-h**, Opercular plates: **e**, S, internal view; **f**, S, external view; **g**, T, internal view; **h**, T, external view. — **i**, Compound rostrum, sutures absent, internal view.

j. — Paratype from Puntan, Madog, Saipan (YPM 9303B). Compound rostrum, sutures present, internal view.

ETYMOLOGY. — From the Latin *ornatus*, 'adorned', in reference to the complex sculpting of the growth ridges on the S.

DISTRIBUTION. — Marianas Islands, 6 m.

Source : MNHN, Paris

Tetrapachylasma trigonum Foster, 1988

Fig. 39; Tables 15-17

Tetrapachylasma trigonum Foster, 1988: 226, figs 1-3.

MATERIAL EXAMINED. — **Cook Islands**. Off Avarua, Rarotonga, 15 m, 09.1984: 2 paratypes, under coral rubble (NMNZ Cr 3641).

TYPES. — *Holotype*: NMNZ CR 3640; Cook Islands, off Avarua, Rarotonga, 15 m, 09.1984; 2, dissected appendages on microslide with dry disarticulated plates kept separately.

Paratypes: NMNZ Cr 3641; Cook Islands, off Avarua, Rarotonga, 15 m, 09.1984; 2 whole specimens, attached to piece of coral rubble, in alcohol.

Holotype and paratype depository: NMNZ.

DIAGNOSIS. — Adult with 4 parietal plates (rostral plate, CL^1 and CL^2 coalesced, and C); plates solid, thin, externally finely stellate basally, outer surface of paries with narrow ribs peripherally. S articular ridge not projecting; external growth ridges ruffled, overlapping, not cut by longitudinal striae. T articular ridge wide, projecting wing-like from articular margin, basal corner hollowed for reception of dwarf males; 6 muscle attachment ridges extending just beyond basal margin. Caudal appendages uni-articulate, 1/8 height of basal segment of pedicel of cirrus VI.

REMARKS. — The 4 plates composing the adult shell, the basal corner of the T articular margin being hollowed for the reception of dwarf males, and the vestigial caudal appendages, distinguish this species. *Tetrapachylasma trigonum* is a moderate sized species (maximum: RC length 10.0, C height 6.4). Differences between *T. trigonum* and *T. arcuatum* sp. nov., *T. aurantiacum*, *T. ferrugomaculosa* and *T. ornatum* sp. nov. are listed under *T. arcuatum*, *T. aurantiacum*, *T. ferrugomaculosa* and *T. ornatum*, respectively.

DISTRIBUTION. — Cook Islands, 15 m.

Subfamily METALASMATINAE nov.

Tables 1-2

DIAGNOSIS. — Primary shell wall not surrounded by whorl(s) of imbricating plates; adult with 6 solid, calcareous, loosely articulated plates (R-CL^1-CL^2-C); thin lamina of chitin dividing paries into inner and outer laminae; externally paries with prominent, irregular growth ridges lined with small setae; external alar growth ridges sinuously parallel to inferior alar margin; superior margins of C alae thickened in distal halves and, to lesser extent, superior margins of alae of CL^1 and CL^2 thickened in distal 1/3, giving dentate appearance; basis membranous; articular ridges of S and T prominent, articular furrow of T well developed; caudal appendages present; mandible tridentoid.

TYPE GENUS. — *Metalasma* gen. nov.

REMARKS. — Only 1 genus, *Metalasma*, is assigned to this subfamily. The metalasmatines have lost any trace of the suture between the R and RL but retain the more plesiomorphic pachylasmatoid basic 6-plated wall. The body morphology of the Metalasmatinae is intermediate between the Pachylasmatinae (retention of the caudal appendages, a tridentoid mandible, form of T) and the Hexelasmatinae (chitin in the parietal wall, form of the cirri - cirrus II resembling I more than III). The presence of caudal appendages, the presence of chitin in the parietal wall, and the tridentoid nature of the mandible, separate the Metalasmatinae from the Bathylasmatinae, which is also phylogenetically between the Pachylasmatinae and the Hexelasmatinae.

Source : MNHN, Paris

ETYMOLOGY. — From the Greek *meta*, 'between', in reference to the intermediate position of this subfamily within the Pachylasmatidae.

DISTRIBUTION. — Recent; Western Pacific: Loyalty Islands; New Hebrides Arc; 300-500 m; attached to stones and Stylasteridae.

Genus ***METALASMA*** gen. nov.

Fig. 45; Tables 18-19

DIAGNOSIS. — As for the subfamily, which is monogeneric.

TYPE SPECIES. — *Metalasma crassum* sp. nov.

REMARKS. — One species is presently assigned to this genus.

TABLES 18 and 19. — *Metalasma* gen. nov.: characters of *M. crassum* sp. nov.

no. plates ext.	no. plates int.	R: RL	CL¹: CL²	T	basis
6	6	n.a.	separate; CL^2 = 1/2 basal width CL^1; CL^2 shorter than CL^1 by 1/10	artic. ridge proj. well beyond artic. margin; spur indistinct, 1/3 width of basal margin, set at 1/6 width basal margin from b-s angle; 13-16 muscle crests, some just extending beyond basal margin	membranous

alar welting	chitin in paries	S shape	S growth lines	caudal appendage	mandible	size (max.)
absent; ala of C with superior alar margin thickened in distal 1/2; alae of CL^1 and CL^2 similarly but less thickened in distal 1/3	lamina of chitin dividing paries into inner (1/4) and outer laminae (3/4)	basal margin 3/4 length of occludent margin; artic. ridge extending beyond artic. margin	many well-spaced, regular; not cut by long. striae	10-12 segs; 2 x length of pedicel of CVI	tridentate; upper margins of teeth 2 and 3 with small subsidiary cusps	RC length 6.5 C height 2.2

artic. = articular; b-s = basi-scutal; distrib. = distribution; ext. = external; int. = internal; max. = maximum; n. a. = not applicable; proj. = projecting; segs = segments.

DISTRIBUTION. — Western Pacific: Loyalty Islands, New Hebrides Arc; 300-500 m; attached to stones and Stylasteridae.

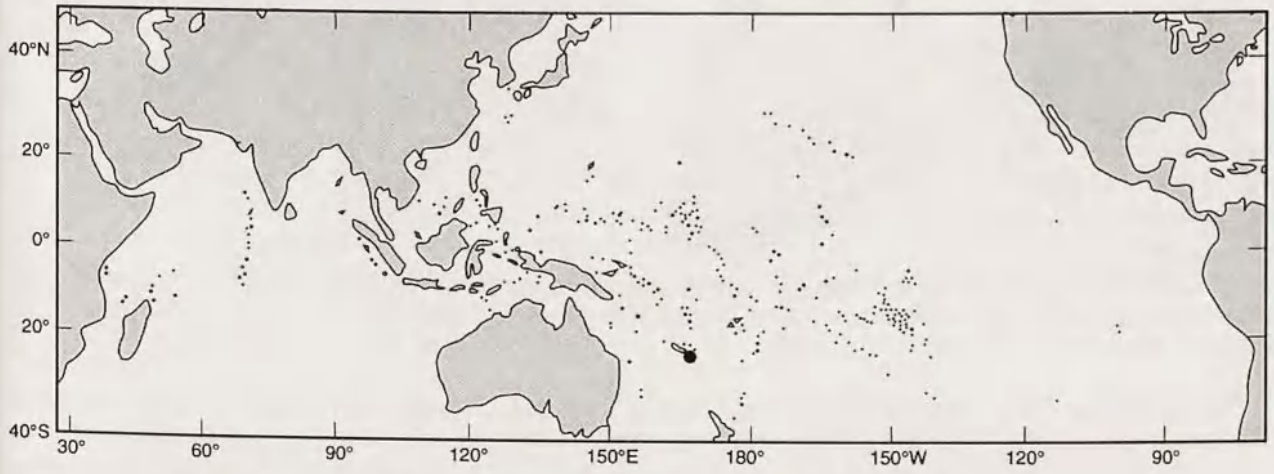

FIG. 45. — *Metalasma* gen. nov. Distribution map: ●, *M. crassum* (300-500 m).

Source : MNHN, Paris

Metalasma crassum sp. nov.

Figs 45-48; Tables 18-19

MATERIAL EXAMINED. — **New Hebrides Arc**. VOLSMAR: stn DW 16, 500 m: 8 specimens (MNHN-Ci 2708).
Loyalty Islands. MUSORSTOM 6: stn DW 460, 420 m: many specimens, attached to rocks (MNHN-Ci 2701). — Stn DW 476, 300 m: 2 specimens (ovigerous), attached to stone (MNHN-Ci 2408, Ci 2409). Drawn. — Stn DW 478, 400 m: 1 specimen (broken), attached to Stylasteridae (MNHN-Ci 2505). — Stn DW 479, 310 m: many specimens, attached to rocks (WAM C 23252).

TYPES. — *Holotype*: MNHN-Ci 2408 (MUSORSTOM 6, stn DW 476).
Paratypes: MNHN-Ci 2409 (MUSORSTOM 6, stn DW 476). Drawn. — MNHN-Ci 2505 (MUSORSTOM 6, stn DW 478). — MNHN-Ci 2701 (MUSORSTOM 6, stn DW 460). — MNHN-Ci 2708 (VOLSMAR, stn DW 16). — WAM C 232-52 (MUSORSTOM 6, stn DW 479).

DIAGNOSIS. — Shell form low, rounded from above. Parietal plates with thin chitinous laminae dividing paries into inner lamina (1/4 thickness) and outer lamina (3/4 thickness). Basal width of CL^2 1/2 basal width of CL^1. Narrow remnants of radii on CL^1, CL^2 and rostral plate. Superior alar margins oblique; carinal superior alar margins thickened in distal 1/2 giving dentate appearance, to lesser extent superior alar margins of CL^1 and CL^2 thickened in distal 1/3. Basis membranous. S externally with many regular growth ridges, not cut by longitudinal striae; articular ridge projecting. Tergal spur indistinct; 13-16 muscle attachment crests, some extending below basal margin; articular ridge projecting. Caudal appendages twice length of pedicel of cirrus VI; 10-12 segmented.

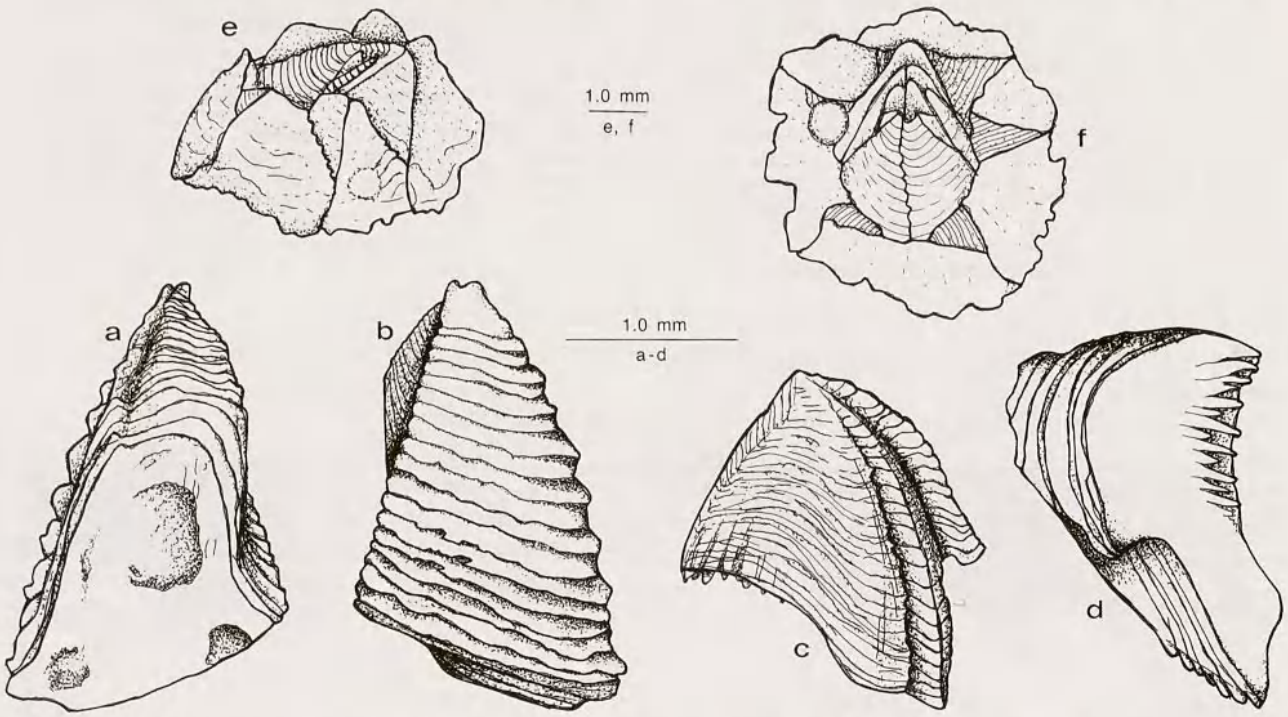

FIG. 46. — *Metalasma crassum* sp. nov. Paratype from MUSORSTOM 6, stn DW 476 (MHNH Ci 2409): **a**, S, internal view; **b**, S, external view; **c**, T, external view; **d**, T, internal view; **e**, whole animal, lateral view; **f**, whole animal, from above.

DESCRIPTION. — Size small (maximum: RC length 6.5, LD 6.9, C height 2.2, R height 2.6). Parietal plates thick basally, externally roughened, irregular growth ridges widely spaced, lined with small setae; chitinous laminae dividing paries into inner and outer laminae, inner lamina 1/4 thickness of outer lamina. Rostral plate flattened, angled inward, apex not curved in toward orifice, basal width twice basal width of C. CL^1 and CL^2

Source : MNHN, Paris

separate; basal width of CL^1 just greater than 1/2 basal width of R, apex not curved in toward orifice; basal width of CL^2 1/2 basal width of CL^1, height less than CL^1 by 1/10; apex not curved in toward orifice. C highest plate, basal width subequal to basal width of CL^1, apex bowed, spout-like, curved away from orifice. Superior alar margins oblique, growth ridges sinuously parallel to inferior alar margins; alae of C widest, alae of CL^1 1/3 width of carinal alae, alae of CL^2 1/2 width of carinal alae; carinal superior alar margins thickened in distal 1/2 giving dentate appearance, to lesser extent superior alar margins of CL^1 and CL^2 thickened in distal 1/3. Narrow remnants of radii on CL^1, CL^2 and rostral plate. Basis membranous, flat. Orifice pentagonal, slightly toothed. Opercular plates lodged subparallel to basis. S triangular; basal margin 3/4 length of occludent margin; externally with many spaced, regular growth ridges, not cut by longitudinal striae; apex pointed; internally adductor muscle scar at 1/2 height of valve; lateral depressor muscle pit well developed; articular furrow moderately deep; articular ridge long, projecting well beyond articular margin; adductor ridge indistinct. T subequal to S, sub-triangular; externally with fine growth ridges; internally with 13-16 depressor muscle crests, some extending just beyond basal margin; prominent tergal articular ridge projecting well beyond and standing clear of convex articular margin; articular furrow broad, deep; indistinct spur, roundly truncate, 1/3 width of basal margin, set at distance of 1/6 width of basal margin from basi-scutal angle. Color of preserved material creamy yellow, opercular plates more yellow; eggs yellow. Measurements of 2 specimens examined as follows:

	RC length	LD	C height	R height
Paratype: MNHN-Ci 2409	5.0	5.5	2.1	1.8
Holotype: MNHN-Ci 2408	6.5	6.9	2.2	2.6

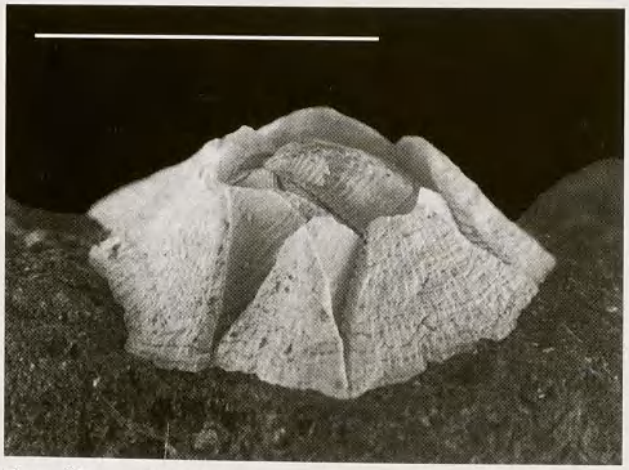

FIG. 47. — *Metalasma crassum* sp. nov. Holotype from MUSORSTOM 6, stn DW 476 (MNHN-Ci 2408): lateral view. Scale = 5 mm.

Labrum with shallow medial depression and numerous small, pointed teeth. Mandibular palp oblong; dense setae terminally. Mandible with 3 teeth, tooth 1 largest, separated from tooth 2 and 3; upper margins of 2 and 3 with small subsidiary cusps; inferior angle large, bluntly molariform, dentate. Maxillule setose; 2 pairs of long, stout setae at upper angle; notch below upper angle large, with 3-4 pairs of smaller setae; straight, stepped cutting margin below with 5-6 pairs of larger setae; inferior angle small, with 4-5 pairs of smaller setae. Maxilla wide; endites indistinct; long, serrulate setae terminally.

Cirrus I with rami subequal; anterior ramus slightly longer than posterior; proximal segments of anterior ramus protuberant anteriorly; both rami moderately setose, setae finely serrulate distally. Cirrus II similar to but slightly longer than cirrus I; rami subequal; proximal segments of anterior ramus slightly protuberant anteriorly; posterior ramus with distal segments antenniform; rami with segments moderately setose, some distal setae serrulate. Cirrus III longer than cirrus II, with rami subequal, segments becoming oblong distally; posterior ramus with 2-4 pairs of long, finely serrulate setae on anterior faces of distal segments, posterior faces with short, spine-like setae; anterior ramus with 2-3 pairs of long, finely serrulate setae on anterior faces of distal segments, proximal segments with 5 pairs. Cirrus IV to VI similar, longer than cirrus III; segments oblong, with 4-5 pairs of setae on anterior faces, distal 2 pairs of setae longest, finely serrulate. Chaetotaxy ctenopod. Cirral formula as follows:

Paratype:		C I	C II	C III	C IV	C V	C VI	c. a.
MNHN-	left	9, 9	9, 12	16, 15	19, 19	21, 21	21, 5+	10
Ci 2409	right	9, 9	11, 12	15, 16	18, 18	21, 20	21, 20+	12

Source : MNHN, Paris

Caudal appendages twice length of pedicel of cirrus VI; 10-12 segmented; apically with sparse, long setae, distal margins of segments with sparse setae, setal length more than 1/2 segmental length. Penis length of proximal segment of pedicel of cirrus VI; finely annulated; sparsely setose with irregular circlet of sparse, short setae apically. Eggs large, ovoid, 0.36 x 0.24 mm.

FIG. 48. — *Metalasma crassum* sp. nov. Paratype from MUSORSTOM 6, stn DW 476 (MHNH Ci 2409): **a**, maxilla; **b**, labrum; **c**, right mandible; **d**, left mandible; **e**, right maxillule; **f**, left maxillule; **g**, mandibular palp; **h**, cirrus I; **i**, cirrus II; **j**, cirrus III, posterior ramus, median segments; **k**, cirrus VI, posterior ramus, median segments; **l**, cirrus VI and caudal appendage; **m**, cirrus III; **n**, cirrus I, posterior ramus, median segments; **o**, penis.

Source : MNHN, Paris

REMARKS. — Specimens of *M. crassum* sp. nov. have been collected, by VOLSMAR and MUSORSTOM 6, from five separate stations which are spatially close. *Metalasma crassum* is remarkable in having a prominent tergal articular ridge extending well beyond and standing clear of the convex articular margin, and an extremely well developed, broad and deep articular furrow. The manner of articulation of the S and T ensure that the T fits closely into the trough formed by the broad carinal alae and the apical portion of the C, and is almost unexposed when the opercular plates are closed.

ETYMOLOGY. — From the Latin *crassa*, 'thick', in reference to the thickened areas on the upper edges of the alae of the C and CL^2 of this species.

DISTRIBUTION. — New Hebrides Arc, Loyalty Islands, 300-500 m.

Subfamily BATHYLASMATINAE Newman & Ross, 1976

Tables 1-2

DIAGNOSIS. — Primary shell wall not surrounded by whorl(s) of imbricating plates. Adult shell wall with 6 (R-CL^1-CL^2-C), or 4 (R-CL-C), solid compartmental plates; paries with prominent horizontal growth ridges lined with small setae; plates thin (*Bathylasma*) or thickened (*Mesolasma*); chitinous laminae in parietal plates absent. External alar growth ridges diverging from inferior alar margin. Basis membranous or calcareous. S with prominent articular ridge; "balanoid" in form. T articular ridge varies from not prominent to prominent. Mandible quadridentoid. Caudal appendages absent.

DISTRIBUTION. — Paleocene to Recent; Cosmopolitan.

REMARKS. — NEWMAN and ROSS (1971) proposed the Bathylasmatidae, in which they included *Bathylasma*, *Hexelasma*, *Aaptolasma*, *Tetrachaelasma* and *Tessarelasma*. FOSTER (1978) indicated that there was only scant evidence for generic differentiation between *Hexelasma* and *Bathylasma*, these genera differing principally in the shape of the spur of the T and the number of paired setae on the anterior edge of the segments of cirrus VI. FOSTER (1978) also showed that there was considerable confusion concerning some of the holotypes of HOEK and suggested that more than 1 taxon may have been involved in the initial description of *H. velutinum* Hoek, 1913. FOSTER (1981) subsequently re-examined the type material, concluding that *H. velutinum* was an aaptolasman and placing *Aaptolasma* in *Hexelasma* as a junior synonym. FOSTER (1981) further proposed the *Mesolasma* for a genus intermediate between *Bathylasma* and *Hexelasma*. *Mesolasma* differed from *Bathylasma* in having opercular plates which lacked prominent articular ridges and from *Hexelasma* in the less specialised setation of the segments of the posterior cirri.

BUCKERIDGE (1983) remarked that the bathylasmatines retained the more primitive pachylasmatoid basic shell construction but had lost any trace of the suture between the R and the RL and that the body morphology was intermediate between the Pachylasmatinae and the Hexelasmatinae. BUCKERIDGE (1983) suggested that *Bathylasma* be retained for those forms with pachylasmatid-like terga, solid calcareous compartments and normal chaetotaxy of the posterior cirri.

The following genera are included within the Bathylasmatinae herein: *Bathylasma*, *Mesolasma*, *Tetrachaelasma* and *Tessarelasma*.

Genus ***BATHYLASMA*** Newman & Ross, 1971

Fig. 49; Tables 20-21

Bathylasma Newman & Ross, 1971: 143.

DIAGNOSIS. — Adult with fixed shell pattern of 6 thin, calcareous compartmental plates (R-CL^1-CL^2-C); parietes with prominent horizontal growth ridges lined with small setae; chitinous laminae absent. External alar

Source : MNHN, Paris

ridges diverging from inferior alar margin; superior alar margin with welting. Basis membranous. Articular ridges of T and S prominent. Mandible quadridentoid. Caudal appendages absent.

TYPE SPECIES. — *Balanus corolliformis* Hoek, 1883.

RECENT SPECIES. — *Bathylasma alearum* (Foster, 1978) Eastern Australia, New Zealand, Vanuatu; 414-1750 m; *B. corolliforme* (Hoek, 1883) (includes *Hexelasma antarcticum* Borradaile, 1916) circum Antarctic; to 1464 m; Pleistocene, to 70 m above sea level.; *B. hirsutum* (Hoek, 1883) North-east Atlantic, from Faeroe Is south to Azores; 944-1829 m.

FOSSIL SPECIES. — *Bathylasma aucklandicum* (Hector, 1888) Oligocene to Pliocene (Duntroonian or Waitakian to Waitotaran); New Zealand. *Bathylasma rangatira* Buckeridge, 1983 Lower Palaeocene to Lower Eocene; Chatham Islands.

REMARKS. — Members of this genus have solid shells, pachylasmatid-like T and normal chaetotaxy of the posterior cirri (FOSTER, 1981).

TABLES 20 and 21. — *Bathylasma*: characters of the species

	no. plates ext.	no. plates int.	R: RL	CL^1: CL^2	T	aperture and plates	basis	alar growth lines
B. alearum (Foster, 1978)	6	6	n.a.	separate; basal width CL^2 = 1/4 basal width CL^1	artic. ridge projecting well beyond artic. margin; spur 1/7 width basal margin, set at 1/14 basal margin from b-s angle; 8-9 muscle crests proj. just below basal margin	parietal plates not flaring; prom. setae on prom. ext. growth lines	membranous	not parallel to inferior alar margin
B. corolliforme (Hoek, 1883)	6	6	n.a.	separate; basal width CL^2 = 1/10 basal width CL^1	artic. ridge projecting well beyond artic. margin; spur indistinct, set at b-s angle; 8-9 muscle crests not proj. below basal margin	parietal plates flaring; short setae on membrane above coarse ext. growth lines	membranous	parallel to inferior alar margin
B. hirsutum (Hoek, 1883)	6	6	n.a.	separate; basal width CL^2 = 1/7 basal width CL^1	artic. ridge projecting beyond artic. margin; spur 1/6 width basal margin, set at 1/12 basal margin from b-s angle; muscle crests not proj. below basal margin	parietal plates not flaring; small setae on fine ext. growth lines	membranous	not parallel to inferior alar margin

	alar welting	chitin in paries	S shape	S growth lines	c.a.	mandible	distribution	depth
B. alearum (Foster, 1978)	conspicuous; narrow	absent	basal margin 7/10 occludent margin; artic. ridge proj. beyond artic. margin	well-spaced, regular; not cut by long. folds	absent	quadridentate; teeth 2-4 with small side teeth; upper and lower margins of tooth 4 with small subsidiary cusps	E Australia, New Zealand, Vanuatu	414-1750 m
B. corolliforme (Hoek, 1883)	conspicuous; narrow	absent	basal margin 3/4 occludent margin; artic. ridge slightly proj. beyond artic. margin	in upper 1/2 well- spaced, narrow in lower 1/2; regular; not cut by long. folds	absent	quadridentate; upper and lower margin of teeth without small subsidiary cusps	circum Antarctic, Pleistocene	to 1464 m 70 m above sea level
B. hirsutum (Hoek, 1883)	wide and flat, 1/2 alar width	absent	basal margin 5/8 occludent margin; artic. ridge proj. beyond artic. margin	many, well-spaced, regular; not cut by long. folds	absent	quadridentate; lower margin of tooth 4 with small subsidiary cusps	NE Atlantic, from Fareoe Is to Azores	944-1829 m

artic. = articular; b-s = basi-scutal; c.a. = caudal appendage; ext. = external; int. = internal; long. = longitudinal; max. = maximum; n.a. = not applicable; proj. = projecting; prom. = prominent; segs = segments.

Source : MNHN, Paris

DISTRIBUTION. — Palaeocene to Recent. Lower Palaeocene to Lower Eocene: Chatham Islands; Oligocene: New Zealand, Victoria; Miocene to Pliocene: New Zealand; Lower Miocene: Burma; Pleistocene to Recent in Antarctica.

Recent: North Atlantic and oceans bordering Antarctica (deep seas): Antarctica, to 1464 m (*B. corolliforme*); New Zealand, eastern Australia, Vanuatu, 414-1750 m (*B. alearum*); N E Atlantic, 944-1829 m (*B. hirsutum*).

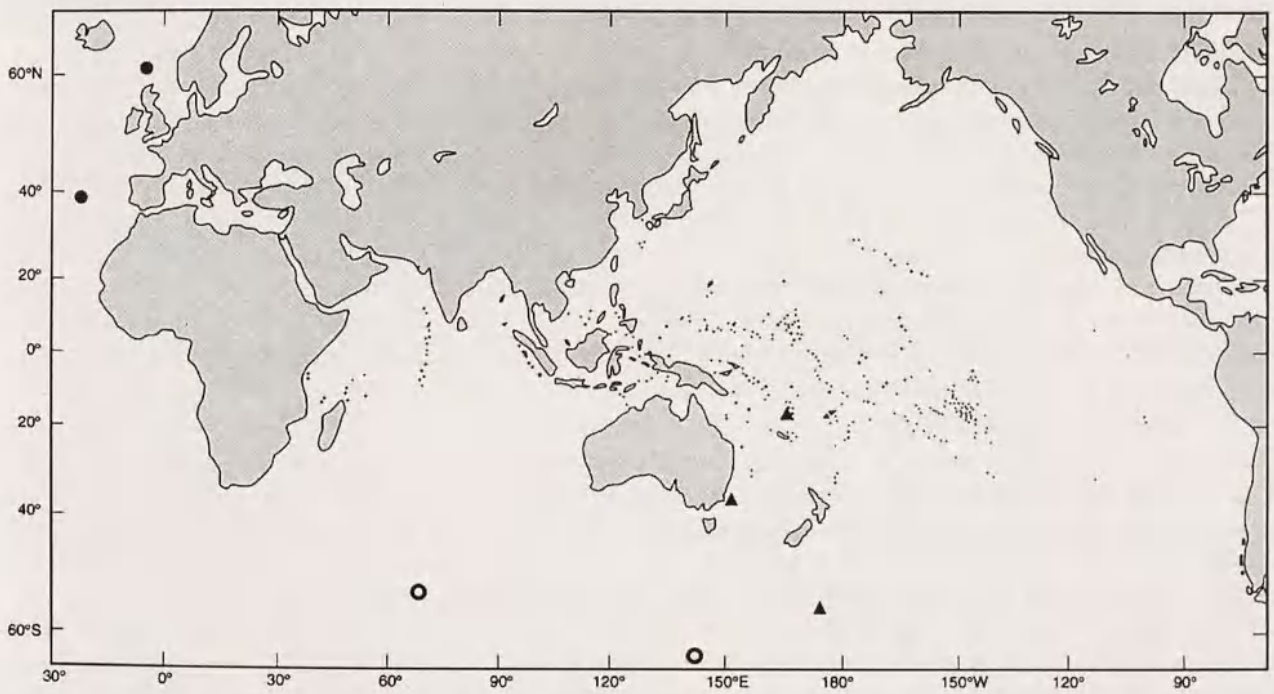

FIG. 49. — *Bathylasma* Newman & Ross, 1971. Distribution map: ○, *B. corolliforme* (to 1464 m); ▲, *B. alearum* (414-1750 m); ●, *B. hirsutum* (944-1829 m).

Bathylasma alearum (Foster, 1978)

Fig. 49; Tables 20-21

Hexelasma alearum Foster, 1978: 80, fig. 49 A-L, pl. 10 A-B.
Bathylasma alearum - FOSTER, 1981: 356.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn DW 1062, 619-658 m: 2 specimens (broken).
New Zealand. NZOI: stn F 132, 49°59'S, 177°32'E, 1335 m, 29.01.1965: holotype, on sponge *Epipolasis novaezelandiae* (NZOI 205).
Australia. Vessel unknown: stn BSS 641 Q, SSE Cape Conran, Victoria, 38°46'S, 148°34.8'E, 1750 m, 17.11.1981: several specimens (AM P 40930).

TYPES. — *Holotype*: NZOI 205; New Zealand, NZOI stn F 132, 49°59'S, 177°32'E, 1335 m, 29.01.1965: on sponge *Epipolasis novaezelandiae*; sandy substrate.
Holotype depository: NIWA.

DIAGNOSIS. — Parietal plates not flared out from orifice; prominent rows of setae on prominent external growth ridges. Basal width of CL^2 1/4 basal width of CL^1. Conspicuous narrow alar welting along superior alar margin; alar growth lines not parallel with inferior alar margin, leaving smooth, triangular extension of internal alar surface on outside towards alar angle beneath growth lines. S externally with regular, well-spaced growth lines, not cut by longitudinal folds; basal margin 7/10 length of occludent margin; articular ridge projecting. T articular ridge projecting well beyond articular margin; spur narrowly rounded, 1/7 width of basal margin, set at 1/14 width

Source : MNHN, Paris

of basal margin from basi-scutal angle; 8-9 strong muscle crests projecting just below basal margin. Mandible with teeth 2-4 with small side teeth, small subsidiary cusps on upper and lower margins of tooth 4.

REMARKS. — During the final preparation of this paper, A. CROSNIER showed me several samples recently collected by the MUSORSTOM 8 expedition in the waters of Vanuatu. Of this material, 2 specimens are identified as *Bathylasma alearum* (Foster, 1978). This record extends the range of *B. alearum* in the waters of the south-western Pacific Ocean, from eastern Australia and New Zealand northwards to Vanuatu.

Bathylasma alearum differs from *B. corolliforme* in a number of characters. In *B. alearum* the parietal plates are not flared out from the orifice, but they are flared in *B. corolliforme*. The basal width of CL^2 is 1/4 the basal width of CL^1 in *B. alearum*, and 1/10 the basal width of CL^1 in *B. corolliforme*. In *B. alearum* the alar growth lines are not parallel with the inferior alar margin; in *B. corolliforme* they are parallel with the inferior alar margin. The S scutal growth lines of *B. alearum* are wide and regular, rather than regular and well-spaced in the upper half of the valve and narrowly spaced in the lower half (*B. corolliforme*). In *B. alearum* the T is externally flat, rather than concave, as in *B. corolliforme*. The T spur of *B. alearum* is distinct, 1/7 the width of the basal margin and set at a distance of 1/14 the length of the basal margin from the basi-scutal corner, with 8-9 muscle attachment crests projecting below the tergal basal margin; in *B. corolliforme* it is indistinct, set at the basi-scutal corner, and the 8-9 muscle crests do not project below the basal margin. In *B. alearum* mandibular teeth 2-4 have small side teeth, and there are small subsidiary cusps on the upper and lower margins of tooth 4; the mandibular teeth of *B. corolliforme* have no side teeth.

Bathylasma alearum is similar to *B. hirsutum* as in both species the parietal plates are not flared out from the orifice and the alar growth lines are not parallel with the inferior alar margin, but there are the following differences between these species. In *B. alearum* the basal width of CL^2 is 1/4 the basal width of CL^1, in *B. hirsutum* 1/7 the basal width of CL^1. The alar welting in *B. alearum* is conspicuous and narrow; in *B. hirsutum* it is wide, flat and 1/2 the alar width. The T spur of *B. alearum* is distinct, 1/7 the width of the basal margin and set at a distance of 1/14 the length of the basal margin from the basi-scutal corner, with the muscle crests projecting below the basal margin; in *B. hirsutum* it is 1/6 the width of the basal margin and set at a distance of 1/12 the length of the basal margin from the basi-scutal corner, with the muscle crests not projecting below the basal margin. The mandible of *B. alearum* has mandibular teeth 2-4 with small side teeth, and small subsidiary cusps on the upper and lower margins of tooth 4; in *B. hirsutum* the lower margin of mandibular tooth 4 has small subsidiary cusps.

FOSTER (1978) noted similarities between *B. alearum* and the fossil *B. aucklandicum*, distinguishing the 2 species on size and the shape of the T articular ridge. BUCKERIDGE (1983) similarly considered *B. aucklandicum* to closely resemble *B. alearum.*

DISTRIBUTION. — New Zealand, eastern Australia, Vanuatu; 414-1750 m.

† ***Bathylasma aucklandicum*** (Hector, 1888)

Scalpellum aucklandicum Hector, 1888: 440.
Pollicipes (?) aucklandicus - BENHAM, 1903: 111. — PARK, 1910: 115, pl. 7 figs 3-7, 10-11.
Pollicipes aucklandicus - CLARKE, 1905: 419.
Hexelasma aucklandicum - WITHERS, 1913: 841, pl. 86 fig. 1; 1924: 19, figs 7-8, pl. 4 figs 1-4, pl. 5 fig. 1. — BUCKERIDGE, 1975: 121, figs 4 c, 5.1, 5.2. — FOSTER, 1978: 82, pl. 10 C-E.
Bathylasma aucklandicum - NEWMAN & ROSS, 1971: 151, pl. 25; 1976: 45; 1981: 356.

TYPES. — *Lectotype*: GS (locality no. 695); rostrum, figured on Pl. LXXXV fig.1.
Syntypes: GS (locality no. 695); 6 rostral compartments, 9 carinal, 13 laterals (8 right and 5 left), 5 carino-laterals (3 right and 2 left), 1 tergum (Pl. LXXXV figs 2-13).
Lectotype and syntypes depository: GS.

DIAGNOSIS. — Shell tall, cylindrical; aperture not flared. Parietal plates solid, calcareous, thin. External alar growth lines fine, diverging from inferior alar margin before turning abruptly downwards towards alar angle then

Source : MNHN, Paris

deflecting apically to form narrow welting along superior alar margin. Sheath insignificant or wanting. S flat with low articular ridge not projecting. T with elevated articular ridge projecting, short spur set close to basi-scutal angle.

REMARKS. — See remarks under *B. alearum* for similarities between *B. aucklandicum* and *B. alearum.*

DISTRIBUTION. — Oligocene to Pliocene (Duntroonian or Waitakian to Waitotaran); New Zealand.

Bathylasma corolliforme (Hoek, 1883)

Fig. 49, Tables 20-21

Balanus corolliformis Hoek, 1883: 155, pl. 6 figs 21-22, pl. 13 figs 1-7.
Hexelasma corolliforme - HOEK, 1913: 245. — PILSBRY, 1916: 330. — NILSSON-CANTELL, 1930: 252, figs 11-1. — ZEVINA, 1968: 94, fig. 6 a-i.
Bathylasma corolliforme - NEWMAN & ROSS, 1971: 143, figs 71-72, pls 15-22, 43 A; 1976: 46. — FOSTER, 1978: 80, fig. 48 A-L; 1981: 356. — BUCKERIDGE, 1989: 333.
Hexelasma antarcticum Borradaile, 1916: 132, fig. 7. — WITHERS, 1924: 22. — BAGE, 1938: 8, pls 5-8. — SPEDEN, 1962: 746. — WEISBORD, 1965: 1015 (part.). — UTINOMI, 1965: 4, figs 1-4, pls 1-2. — WEISBORD, 1967: 51 (part.), figs 1-6, pls 1-2. — ZEVINA, 1968, fig. 1.

TYPES. — *Holotype*: BMNH 85.17; near Kerguelen I., *"Challenger":* stn 150, 52°4'S, 71°22'E, 274 m, 02.02.1874.

Paratype: BMNH 1917.2.9.59; *"Terra Nova"* Expedition.

Holotype and paratype depository: BMNH. (paratype specimen has not been located in the collection of BMNH) [Ms A. MORGAN, pers. comm., 05.02.1996].

MATERIAL EXAMINED. — **Near Kerguelen Island**. *"Challenger"*: stn 150, 52°04'S, 71°22'E, 274 m, 02.02.1874: holotype (BMNH 85.17).

Antarctic. ANZARE: stn III, 66°32'S, 141°39'E, 297 m, 31.12.1913: 1 specimen (AM P 7206); 1 specimen (AM P 7207); 1 specimen (AM P 7209); 1 incomplete specimen (AM P 7210); 1 specimen (AM P 7211). All identified *Hexelasma antarcticum* Borradaile, 1916.

DIAGNOSIS. — Parietal plates flared out from orifice; rows of short setae on persistent membrane above coarse, external growth ridges. Basal width of CL^2 1/10 basal width of CL^1. Alae oblique; conspicuous, narrow alar welting along superior alar margin; alar growth lines parallel with inferior alar margin. S externally concave, with regular, well-spaced growth lines in upper half of valve, growth lines narrowly spaced in lower half, growth lines not cut by longitudinal folds; S basal margin 3/4 length of occludent margin; articular ridge slightly projecting. T externally concave, articular ridge projecting well beyond articular margin; spur indistinct, set almost at basi-scutal angle; 8-9 muscle crests not projecting below basal margin. Mandible with 4 teeth, small subsidiary cusps on upper and lower margins of teeth absent.

REMARKS. — The flaring orifice, the coarse growth ridges on the parietes and the alar growth ridges running along and closely paralleling the inferior alar margins distinguish this species. Differences between *B. corolliforme* and *B. alearum* are listed under *B. alearum.*

Bathylasma corolliforme differs from *B. hirsutum* as the parietal plates are flared out from the orifice in the former, rather than not flared in the latter; the growth lines of the parietal plates are coarse, rather than fine; and the alar growth lines are parallel, rather than not parallel, with the inferior alar margin. In *B. corolliforme* the basal width of CL^2 is 1/10 the basal width of CL^1, in *B. hirsutum* 1/7 the basal width of CL^1. The alar welting in *B. corolliforme* is conspicuous and narrow; in *B. hirsutum* it is wide, flat and 1/2 the alar width. The S scutal growth lines are regular and well-spaced in the upper half of the valve and narrowly spaced in the lower half in *B. corolliforme*; in *B. hirsutum* they are uniformly wide and regular. The T spur of *B. corolliforme* is indistinct, set almost at the basi-scutal corner, with the muscle crests not projecting below the basal margin; in *B. hirsutum* it is 1/6 the width of the basal margin and set at a distance of 1/12 the length of the basal margin from the basi-scutal corner, with the muscle crests not projecting below the basal margin. The mandible of *B. corolliforme*

Source : MNHN, Paris

has no subsidiary cusps on the upper and lower margins of tooth 4; in *B. hirsutum* the lower margin of mandibular tooth 4 has small subsidiary cusps.

DISTRIBUTION. — Circum Antarctic, to 1464 m; Pleistocene, to 70 m above sea level.

Bathylasma hirsutum (Hoek, 1883)

Fig. 49; Tables 20-21

Balanus sp. Jeffreys, 1878: 414 (*fide* SOUTHWARD & SOUTHWARD, 1958).
Bathylasma hirsutus Hoek, 1883: 158, pl. 13 figs 8-15. — GRUVEL, 1920: 55, pl. 1 figs 13-14.
Hexelasma hirsutum - HOEK, 1913: 245. — PILSBRY, 1916: 330. — SOUTHWARD & SOUTHWARD, 1958: 635. — UTINOMI, 1965: 11. — FOSTER, 1978: 79.
Bathylasma hirsutum - NEWMAN & ROSS, 1971: 149, fig. 73, pls 23-24; 1976: 46. — FOSTER, 1981: 356. — YOUNG, 1998: 66.

TYPES. — *Holotype*: BMNH 85.17; Faeroe Channel, *"Triton"*: stn 10, 59°40'N, 7°21'W, 944 m, 24.10.1882. *Holotype depository*: BMNH.

MATERIAL EXAMINED. — **Faeroe Channel**. *"Triton"*: stn 10, 59°40'N, 7°21'W, 944 m, 24.10.1882: holotype (BMNH 85.17).

DIAGNOSIS. — Parietal plates thin, not flared out from orifice; rows of setae on yellow membrane above fine external growth ridges. CL^1 and CL^2 separate; basal width of CL^2 1/7 basal width of CL^1. Wide, flat alar welting along superior alar margin, 1/2 alar width; alar growth lines not parallel with inferior alar margin. S externally with regular, well-spaced growth lines, not cut by longitudinal folds; basal margin 5/8 length of occludent margin; articular ridge projecting. T articular ridge projecting well beyond articular margin; spur truncate, 1/6 width of basal margin, set at 1/12 width of basal margin from basi-scutal angle; muscle crests not projecting below basal margin. Mandible with lower margin of tooth 4 with small subsidiary cusps.

REMARKS. — This species can be distinguished by the non-flared aperture and by the fine, external growth ridges of the thin parietal plates. In addtion the alar growth ridges are removed from and do not closely parallel the inferior alar margin, and the upturned alar margins of CL^1 and CL^2 are wide, 1/2 the width of the entire ala, and flat. Differences between *B. hirsutum* and *B. alearum* and *B. corolliforme* are listed under *B. alearum* and *B. corolliforme*, respectively

DISTRIBUTION. — North-east Atlantic, from the Faeroe Islands south to the Azores; 944-1829 m.

Genus ***MESOLASMA*** Foster, 1981

Fig. 50; Tables 22-23

Mesolasma Foster, 1981: 362.

DIAGNOSIS. — Adult with fixed shell pattern of 6 thickened, solid, calcareous compartmental plates including discrete rostral plate, paired CL^1 and CL^2, and C (R-CL^1-CL^2-C); externally with prominent horizontal growth ridges lined with small setae and small beads; paries thickened and inflected inward basally; chitinous laminae absent. External alar growth ridges diverging from inferior alar margin; superior alar margin with narrow welting. Basis thin, calcareous. Articular ridge of S not prominent. Articular ridge of T not prominent. Mandible tridentoid or quadridentoid. Segments of posterior cirri longer than wide, with graded series of 3 or more setae on anterior edge. Caudal appendages absent.

TYPE SPECIES. — *Mesolasma fosteri* (Newman & Ross, 1971).

Source : MNHN, Paris

TABLES 22 and 23. — *Mesolasma*: characters of *Mesolasma fosteri*.

no. plates ext.	no. plates int.	R:RL	CL[1]: CL[2]	T	paries	basis	alar growth lines
6	6	n.a.	separate;basal width CL[2] subequal to basal width CL[1]	not proj.; spur pointed, 1/4 width basal margin, set 1/12 width basal margin from b-s angle	thickened; inflected inward basally; horizontal growth ridges prominent, lined with small setae	calcareous	diverging from inferior alar margin

alar welting	chitin in paries	S shape	S growth lines	c.a.	mandible	size	distribution	depth
narrow	absent	artic. ridge not proj. beyond artic. margin	well-spaced, regular; not cut by long. striae	absent	tri- or quadri-dentate; upper and lower margins of teeth 3 and 4 sometimes with small subsidiary cusps	RC length 5.0 C height 4.0	New Zealand	490-1556 m

artic. = articular; b-s = basi-scutal; c.a. = caudal appendage; ext. = external; int. = internal; n.a. = not applicable; proj. = projecting.

REMARKS. — One species only is presently assigned to this genus. The genus occupies an intermediate position between *Bathylasma* and *Hexelasma* (FOSTER, 1981). The opercular plates of *Mesolasma* are more balanoid-like, lacking the prominent articular ridges found in *Bathylasma*, whereas the setation of the segments of the posterior cirri is less specialized than that found in *Hexelasma*.

DISTRIBUTION. — Oligocene to Recent. Oligocene: Victoria, Australia. Recent: Western Pacific Ocean: New Zealand, Norfolk and Kermadec Islands; 490-1556 m.

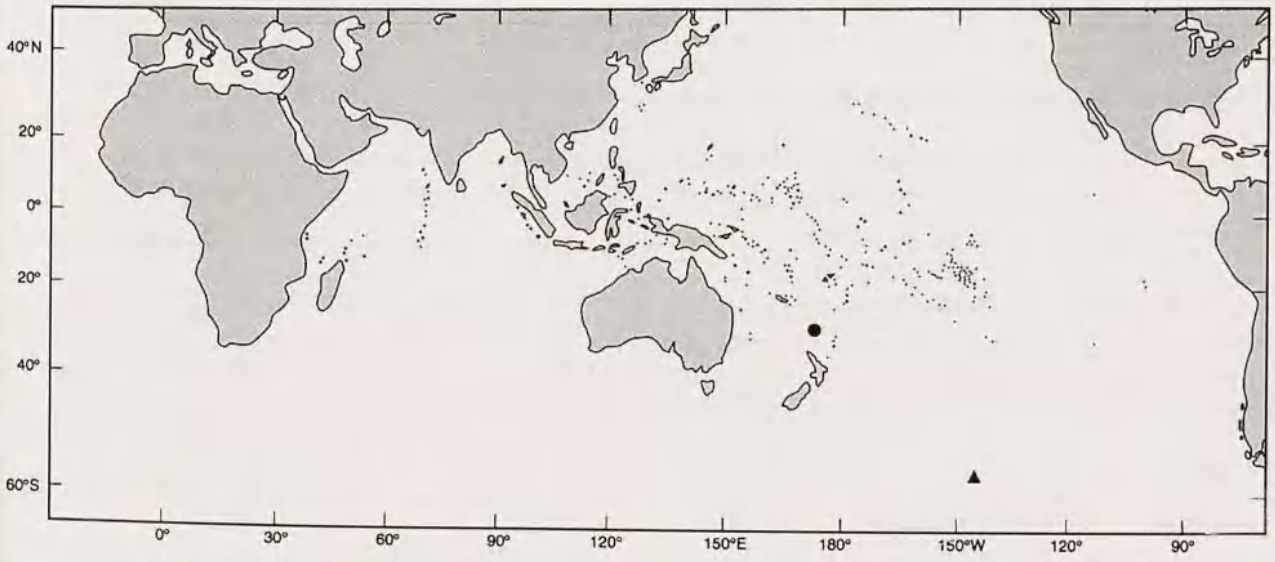

FIG. 50. — *Mesolasma* Foster, 1981 and *TETRACHAELASMA* Newman & Ross, 1971. Distribution map: ●, *M. fosteri* (490-556 m); ▲, *T. southwardi* (1190-2328 m).

Mesolasma fosteri (Newman & Ross, 1971)

Fig. 50; Tables 22-23

Hexelasma fosteri Newman & Ross, 1971: 155, figs 75-76; 1976: 46.
Aaptolasma fosteri - FOSTER, 1978: 83 (part). Not pl. 10F, fig 50 (= *Hexelasma gracilis* Foster, 1981).
Mesolasma fosteri - FOSTER, 1981: 362, figs 8 C, 9.

Source : MNHN, Paris

MATERIAL EXAMINED. — **New Zealand**. TUI EXPED.: stn 011-14, north of Auckland, 30°45'S, 173°51'E, 538-676 m: holotype (USNM Type 125310).

TYPES. — *Holotype*: USNM Type 125310; New Zealand, TUI Exped., stn 011-14, north of Auckland, 30°45'S, 173°51'E, 538-676 m, with *Megalasma striatum* Hoek and *Trilasmis kaempferi* (Darwin), the former on the spine of echinoid, substratum of others unknown; slides (3).

Holotype depository: USNM.

DIAGNOSIS. — As for the genus.

DISTRIBUTION. — New Zealand, Norfolk and Kermadec Islands; 490-1556 m.

Genus ***TETRACHAELASMA*** Newman & Ross, 1971

Fig. 50; Tables 24-25

Tetrachaelasma Newman & Ross, 1971: 152.

DIAGNOSIS. — Adult with fixed shell pattern of 4 thick, solid, calcareous compartmental plates including compound rostral plate, paired CL, and C (R-CL-C); parietes with fine horizontal growth ridges lined with small setae; chitin absent. External alar ridges diverging from inferior alar margin; superior alar margin with narrow, coarse welting. Basis membranous. S with prominent articular ridge. T similar to that of *Bathylasma* but articular margin sinusoidal rather than straight or concave; lateral depressor muscle crests few, restricted to small area below carinal angle. Rami of cirri II and III antenniform; intermediate articles of cirrus VI bearing 3 or 4 pairs of major setae. Mandible quadridentoid. Caudal appendages absent.

TYPE SPECIES. — *Tetrachaelasma southwardi* Newman & Ross, 1971.

REMARKS. — Only one species is presently assigned to this genus.

TABLES 24-25. — *Tetrachaelasma*: characters of the species

no. plates ext.	no. plates int.	R:RL	CL^1:CL^2	T	paries	basis	alar growth lines
4	4	n.a.	CL present	artic. ridge proj.; spur at b-s angle	heavy; thick; horizontal growth ridges fine; lined with small setae	membranous	diverging from inferior alar margin

alar welting	chitin in paries	S shape	S growth lines	c.a.	mandible
narrow, coarse	absent	artic. ridge prominent	small, well-spaced, regular; not cut by long. striae	absent	quadridentate; margins of teeth 1-3 smooth; lower margin of tooth 4 with small subsidiary cusps

artic. = articular; b-s = basi-scutal; c.a. = caudal appendage; ext. = external; int. = internal; long. = longitudinal; max. = maximum; n.a. = not applicable; proj. = projecting; segs = segments.

DISTRIBUTION. — Southern Pacific Ocean, Antarctic Basin and off South America; 1190-2328 m.

Tetrachaelasma southwardi Newman & Ross, 1971

Fig. 50; Tables 24-25

Hexelasma antarcticum Borradaile, 1916: 132 (part). — WEISBORD, 1965: 1015 (part); 1967: 51, pl. 2 figs 7-8 (part).
Tetrachaelasma southwardi Newman & Ross, 1971: 152, fig. 74, pls 26-31.

MATERIAL EXAMINED. — **South Pacific Ocean**.*"Eltanin"*: SOSC stn 6, 52°10'S, 142°10'W, 1260-1273 m, 20.03.1965: holotype (USNM 125305).

Source : MNHN, Paris

TYPES. — *Holotype*: USNM 125305; South Pacific Ocean, *"Eltanin"*, SOSC stn 6, 52°10'S, 142°10'W, 1260-1273 m, 20.03.1965; dry (1 lot) and slide (1 lot).

Paratypes: USNM 125306, South Pacific Ocean, *"Eltanin"*, SOSC stn 6, 52°10'S, 142°10'W, 1260-1273 m, 20.03.1965. — USNM 125307, off Falkland Is, *"Eltanin"*, SOSC stn 376, 54°03'S, 56°03'W, 1720-1739 m, plates only. — USNM 125308, off southern Chile, *"Eltanin"*, SOSC stn 216, 52°53'S, 75°36'W, 1190-1263 m, plates only. — USNM 125309, off Cape Horn, *"Eltanin"*, SOSC stn 255, 59°45'S, 68°50'W, 1207-1591 m, plates only, in alcohol.

Holotype and paratype depository: USNM.

DIAGNOSIS. — As for the genus.

REMARKS. — The 4-platedness is due to the compound R and the absence of CL^2 (NEWMAN & ROSS, 1971). The morphology of this species is puzzling, not only because of the massive 4-plated wall and absence of radii, but also because of the flaring orifice and exceptionally broad carinal alae that internally contribute to about 1/2 of the sheath's circumference. Apparently, it reflects an early radiation into the deep sea, and has a combination of plesiomorphic and apomorphic characters that have likely evolved from the chionelasmatid level of organisation and, therefore, its relationship remains to be resolved.

DISTRIBUTION. — Southern Pacific Ocean, Antarctic Basin and off South America; 1190-2328 m.

Genus *TESSARELASMA* Withers, 1936

Tables 26-27

Tessarelasma Withers, 1936: 591.

DIAGNOSIS. — Adult with fixed shell pattern of 4 solid, calcareous compartmental plates including compound rostral plate, paired CL, and C (R-CL-C). External alar ridges diverging from inferior alar margin; superior alar margin with narrow welting. Basis calcareous, marginally thickened, appearing as inflection of wall. S lacking prominent articular ridge, with area above shallow adductor muscle pit roughened as in *Hesperibalanus*.

TYPE SPECIES. — † *Tessarelasma pilsbryi* Withers, 1936.

REMARKS. — The T and the soft parts of this species are unknown. NEWMAN and ROSS (1971: 155) commented that the S is more balanoid than chthamaloid in appearance, whereas the structure of the basis is chthamaloid or bathylasmatid, suggesting an intermediate position between the chthamaloids and the balanoids. For these reasons they tentatively suggested bathylasmatid affinities for *Tessarelasma*. The genus is only known from the fossil record and is monospecific.

DISTRIBUTION. — Lower Miocene; Burma.

TABLES 26 and 27. — *Tessarelasma*: characters of the species

no. plates ext.	no. plates int.	R:RL	CL^1:CL^2	T	paries	basis	alar growth lines
4	4	n.a.	CL present	unknown	solid	calcareous, marginally thickened, as inflection of wall	diverging from inferior alar margin

alar welting	chitin in paries	S shape	S growth lines	c.a.	mandible
narrow, coarse	absent	balanoid, artic. ridge proj.	well-spaced, regular; not cut by long. striae	unknown	unknown

artic. = articular; c.a. = caudal appendage; ext. = external; int. = internal; long. = longitudinal; n.a. = not applicable; proj. = projecting.

Source : MNHN, Paris

† *Tessarelasma pilsbryi* Withers, 1936

Tables 26-27

Tessarelasma pilsbryi Withers, 1936: 591. — NEWMAN & ROSS, 1971: 155; 1976: 46.

TYPES. — *Holotype*: No registration number. Lower Miocene. Eastern Bengal in grey shale and greenish-grey sandstone, containing pebbles of shale, and forming part of the Surma series, about 2000 feet below the base of the Tipam Sandstone.

Holotype depository: Geological Department, BMNH.

DIAGNOSIS. — As for the genus.

REMARKS. — As for the genus.

DISTRIBUTION. — Lower Miocene; Burma.

Subfamily HEXELASMATINAE Newman & Ross, 1976

Tables 1-2

DIAGNOSIS. — Primary shell wall not surrounded by whorl(s) of imbricating plates. Adult shell wall with 6 plates (R-CL^1-CL^2-C) divided into inner and outer laminae by longitudinal chitinous rods; externally with prominent horizontal growth ridges lined with small setae. External alar growth ridges parallel to or diverging from inferior alar margin; superior alar margin with narrow to moderate welting. Basis calcareous, thin centrally; sometimes membranous. Opercular plates with articular ridges not prominent. Mandible quadridentoid. Caudal appendages absent.

REMARKS. — Only one genus, *Hexelasma*, is contained in this sub-family. Heretofore 9 species were included in *Hexelasma*. Six new species are described in the present report bringing to 15 the number of hexelasmatines presently known.

DISTRIBUTION. — Eocene to Recent. Eocene: Tonga. Lower Miocene: Victoria. Recent: Western Atlantic, Indo-west Pacific, Australasia.

Genus ***HEXELASMA*** Hoek, 1913

Figs 51, 64; Tables 28-30

Hexelasma Hoek, 1913: 244 (in part.). — PILSBRY, 1916: 329. — KRÜGER, 1940: 30. — WITHERS, 1953: 99. — UTINOMI, 1965: 13; 1968: 30. — ZEVINA, 1968: 64. — NEWMAN & ROSS, 1971: 155.
Aaptolasma Newman & Ross, 1971: 158. — FOSTER, 1981: 356.

DIAGNOSIS. — As for the subfamily, which is monogeneric.

TYPE SPECIES. — *Hexelasma velutinum* Hoek, 1913.

RECENT SPECIES. — *Hexelasma americanum* Pilsbry, 1916; *H. arafurae* Hoek, 1913; *H. aureolum* sp. nov.; *H. brintoni* (Newman & Ross, 1971); *H. callistoderma* Pilsbry, 1911; *H. flavidum* sp. nov.; *H. foratum* sp. nov.; *H. globosum* sp. nov.; *H. gracilis* Foster, 1981; *H. leptoderma* (Newman & Ross, 1971); *H. nolearia* (Foster, 1978); *H. persicum* sp. nov.; *H. sandaracum* sp. nov.; *H. triderma* (Newman & Ross, 1971); *H. velutinum* Hoek, 1913.

Source : MNHN, Paris

TABLE 28. — *Hexelasma*: characters of the species

	no. plates ext.	no. plates int.	R:RL	CL^1:CL^2	T	basis
H. americanum Pilsbry, 1916	6	6	n.a.	separate; basal width CL^2 = 1/3 basal width CL^1	artic. ridge not proj.; spur obliquely truncate, width 1/3 basal margin, slightly removed from b-s angle; inner surface smooth	membranous, with narrowly inflected calcareous borders
H. arafurae Hoek, 1913	6	6	n.a.	separate; basal width $CL^2 \geq 1/2$ basal width CL^1	artic. ridge not proj.; spur truncate, >1/3 width of basal margin, set almost at b-s angle; inner surface smooth	calcareous, thin
H. aureolum sp. nov.	6	6	n.a.	separate; basal width CL^2 = 1/4-1/3 basal width CL^1	artic. ridge not proj.; spur truncate, 1/4 width of basal margin, set at its own width from b-s angle; inner surface rough with 6-9 irregular. low ridges and beading	calcareous, thin
H. brintoni (Newman & Ross, 1971)	6	6	n.a.	separate; basal width CL^2 = 3/5 basal width CL^1	artic. ridge not proj.; spur truncated,1/3 width of basal margin, forming abrupt angle of 130° with basal margin; spur set at 1/2 its own width from b-s angle; inner surface smooth	calcareous, thick
H. callistoderma Pilsbry, 1911	6	6	n.a.	separate; basal width CL^2 = 1/4-1/5 basal width CL^1	artic. ridge not proj.; spur broadly 1/4 width of basal margin; spur set at 1/2 its width from b-s angle; inner surface roughened distally with linear beading	membranous (young); with thick calcareous ledge (adults)
H. flavidum sp. nov.	6	6	n.a.	separate; basal width CL^2 = 1/3 or <1/3 basal width CL^1	artic. ridge not proj.; spur truncated, >1/3 width of basal margin forming abrupt angle of 130° with basal margin; spur set at 1/4 its own width from b-s angle; inner surface roughened	calcareous edges, membranous centrally; thin
H. foratum sp. nov.	6	6	n.a.	separate; basal width CL^2 = 1/4-1/3 basal width CL^1	artic. ridge not proj.; spur truncate, 3/10 width of basal margin, set at less than 1/2 its own width from b-s angle; inner surface roughened over 2/3 of surface	calcareous; thick; pinprick holes perforating junction of basis and inner parietal surface
H. globosum sp. nov.	6	6	n.a.	separate; basal width CL^2 = 1/2 basal width CL^1	artic. ridge proj., spur truncate, 1/4 width of basal margin, set at distance of < 1/2 its width from b-s angle; inner surface rough over 2/3 surface	calcareous; thin
H. gracilis Foster, 1981	6	6	n.a.	separate; basal width CL^2 sub = to basal width CL^1	artic. ridge not proj.; spur rounded, 1/4 width of basal margin, set at 1/2 its width from b-s angle; inner surface smooth	with wide calcareous ledge
H. leptoderma (Newman & Ross, 1971)	6	6	n.a.	separate; basal width CL^2 = 1/2 basal width CL^1	artic. ridge not proj.; spur pointed, 1/4 width of basal margin, set at 1/2 its width from b-s angle; inner surface rough distally	calcareous
H. nolearia (Foster, 1978)	6	6	n.a.	separate; basal width CL^2 = 1/2 basal width CL^1	artic. ridge not proj., artic. margin convex; spur indistinct, 1/3 width of basal margin, set at b-s angle; inner surface roughened distally	calcareous
H. persicum sp. nov.	6	6	n.a.	separate; basal width CL^2 = 1/2 basal width CL^1	artic. ridge not proj.; spur truncated, broad, 1/4 width of basal margin; spur set at 1/3 its width to b-s angle; inner surface roughened distally	calcareous; thin
H. sandaracum sp. nov.	6	6	n.a.	separate; basal width CL^2 = 1/3-1/2 basal width CL^1	artic. ridge not proj.; spur truncated, broad, 1/4 width of basal margin; spur set at 1/2 its width from b-s angle; inner surface slightly roughened in upper 1/2	calcareous; thin
H. triderma (Newman & Ross, 1971)	6	6	n.a.	separate; basal width CL^2 = 1/2-2/3 basal width CL^1	unknown	calcareous
H. velutinum Hoek, 1913	6	6	n.a.	separate; basal width CL^2 = 2/3 basal width CL^1	artic. ridge not proj.; spur truncated, 1/3 width of basal margin, set at 1/12 length of basal margin from basi-scutal angle; inner surface smooth	calcareous, thin

Source : MNHN, Paris

TABLE 29. — *Hexelasma*: characters of the species (continued)

	S shape	S growth lines	c.a.	mandible
H. americanum Pilsbry, 1916	S basal margin 1/2 length of S occludent margin; adductor ridge absent; few crests for lateral depressor muscles present; inner surface smooth; S artic. ridge not proj.	regular, smooth; long. striae absent	absent	quadridentate; teeth acute, upper and lower margins of teeth smooth
H. arafurae Hoek, 1913	S basal margin 2/3 length of S occludent margin; adductor ridge present; crests for lateral depressor muscles present; inner surface rough; S artic. ridge not proj.	smooth, even; cut by 1 broad, long. stria	absent	quadridentate; upper margins of teeth 3 and 4 with small subsidiary cusps
H. aureolum sp. nov.	S basal margin 9/14 length of S occludent margin; adductor ridge weak; crests for lateral depressor muscles present; inner surface with irregular beading distally; S artic. ridge slightly proj.	sinuous, transverse, cut by 2 narrow, long. striae	absent	quadridentate; 1 small subsidary tooth sometimes between teeth 3 and 4; lower margin of tooth 4 with 1 small subsidiary cusp
H. brintoni (Newman & Ross, 1971)	S basal margin 2/3 length of S occludent margin; adductor ridge present; crests for lateral depressor muscles present; inner surface smooth; S artic. ridge not proj.	smooth, even, widely spaced; not cut by long. stria	absent	quadridentate; teeth 2 and 3 with side teeth, upper and lower margins of tooth 4 with small subsidiary cusps
H. callistoderma Pilsbry, 1911	S basal margin 5/9 length of S occludent margin; adductor ridge faint; crests for lateral depressor muscles present; inner surface smooth; S artic. margin not projecting	smooth, even; not cut by long. stria	absent	quadridentate; upper and lower margins of teeth smooth
H. flavidum sp. nov.	S basal margin 9/14 length of S occludent margin; adductor ridge weak; crests for lateral depressor muscles slight; inner surface smooth; S artic. ridge not proj.	sinuous, well-spaced; cut by slight, long. striae	absent	quadridentate; upper and lower margins of tooth 4 with irregular, small, subsidiary cusps
H. foratum sp. nov.	S basal margin 4/7 length of S occludent margin; adductor ridge weak; crests for lateral depressor muscles absent; inner surface roughened distally; S artic. ridge slightly proj.	sinuous, widely spaced; not cut by long. striae	absent	quadridentate; teeth 2 and 3 each with 1 small subsidiary cusp; upper and lower margins of tooth 4 with irregular, small subsidiary cusps
H. globosum sp. nov.	S basal margin 2/3 length of S occludent margin; adductor ridge weak; crests for lateral depressor muscles absent; inner surface smooth; S artic. ridge slightly proj.	sinuous, well spaced; cut by 3 slight, long. striae, middle stria most marked	absent	quadridentate; upper and lower margins of tooth 4 with irregular, small subsidiary cusps
H. gracilis Foster, 1981	S basal margin 3/4 length of S occludent margin; adductor ridge faint; crests for lateral depressor muscles faint; inner surface smooth; S artic. ridge not proj.	sinuous, widely spaced; not cut by long. striae	absent	quadridentate; tooth 2 with side teeth
H. leptoderma (Newman & Ross, 1971)	S basal margin 9/14 length of S occludent margin; adductor ridge present; crests for lateral depressor muscles present; inner surface roughened distally; S artic. ridge not proj.	smooth, well spaced, not cut by long. striae	absent	quadridentate; upper and lower margins of tooth 4 with small subsidiary cusps
H. nolearia (Foster, 1978)	S basal margin 4/7 length of S occludent margin; adductor ridge prominent; crests for lateral depressor muscles faint; inner surface smooth; S artic. ridge not proj.; occludent and articular margins folded	smooth, well spaced, not cut by long. striae	absent	tri- or quadri-dentate; upper and lower margins of all teeth smooth
H. persicum sp. nov.	S basal margin 9/16 length of S occludent margin; adductor ridge weak; crests for lateral depressor muscles feeble or absent; inner surface smooth; S artic. ridge not proj.; occludent and articular margins folded	sinuous, narrowly spaced; cut by 3 faint long. striae, 2 near occludent margin, 1 near artic. margin (latter only marked in lower 1/2)	absent	quadridentate; tooth 2 with 1 to several small subsidiary cusps; upper and lower margins of tooth 4 with small, irregular, subsidiary cusps
H. sandaracum sp. nov.	S basal margin 9/15 length of S occludent margin; adductor ridge feeble; crests for lateral depressor muscles low; inner surface smooth; S artic. ridge not proj.; occludent and articular margins folded, rounded	sinuous, widely spaced; cut by 3 long. striae, 2 near occludent margin (stria near middle most definite), 1 near artic. margin (marked only for 2/3 length)	absent	quadridentate; upper margin of tooth 3 with 1 or more small subsidiary cusps; upper and lower margins of tooth 4 with small, irregular, subsidiary cusps

Source : MNHN, Paris

H. triderma (Newman & Ross, 1971)	unknown	unknown	absent	unknown
H. velutinum Hoek, 1913	S convex ext.; convex basal margin 2/3length of S occludent margin; adductor ridge weak; crests for lateral depressor muscles absent; inner surface distally roughened; S artic. ridge not proj.; occludent and articular margins folded, roughened	smooth, widely spaced; not cut by 3 long. striae	absent	quadridentate; upper margins of teeth 2-4 with side teeth; lower margin of 4 with small subsidiary cusps; lower angle produced into single or bifid spine

artic. = articular; b-s = basi-scutal; c.a. = caudal appendage; ext. = external; int. = internal; n.a. = not applicable; long. = longitudinal; proj. = projecting.

TABLE. 30. — *Hexelasma*: characters of the species (continued)

	welting on supra alar margin	**chitin in paries**	**color of opercular valves**	**persistent epidermis**
H. americanum Pilsbry, 1916	narrow; inferior alar margin not curved, with slight hook at free end	as long rods, sub-arcuate in x-section, regularly spaced, separated by calcareous bridges	pale orange	thin, pale color
H. arafurae Hoek, 1913	inconspicuous; externally with strong growth ridges	continuous lamina of chitin bisecting thickness of parietal plates	orange to brick red	absent
H. aureolum sp. nov.	sometimes inconspicuous; narrow; inferior alar margin curved, with slightly basally directed hook at free end; externally with fine, narrow growth ridges	as lamina on inner surface of paries, or as rods separating paries into inner (1/4) and outer (3/4) laminae	whitish apically, sometimes pink orange-brown	thick; golden yellow
H. brintoni (Newman & Ross, 1971)	ridged, narrow; inferior alar margin curved, without basally directed hook at free end; externally with weakly marked growth ridges	long rods, sub-arcuate in x-section, regularly spaced, separated by broad calcareous bridges, bisecting thickness of parietal plates	white	brownish
H. callistoderma Pilsbry, 1911	thin; rough; externally with fine alar growth ridges	long rods, sub-arcuate in x-section, separated by regularly spaced, broad calcareous bridges	white	present on S and T
H. flavidum sp. nov.	serrate edge; narrow, ridged; inferior alar margin curved, slight hook at free end; externally with growth ridges well spaced	as lamina on inner surface of paries, between long. ribs, and within paries as long. rods, separating paries into inner (1/4) and outer (3/4) laminae	golden-orange externally, cream apices; orange- cream internally	absent
H. foratum sp. nov.	narrow, ridged, increasing in length toward free end; inferior alar margin curved, without distal hook at free end	long., spaced rods bisecting thickness of parietal plates	whitish	yellow
H. globosum sp. nov.	ridged, narrow at summit, wider toward alar angle; inferior alar margin curved, without hook at free end	thin lamina applied in long strips to inner surfaces of paries	whitish	absent
H. gracilis Foster, 1981	narrow, ridged; externally with growth ridges well marked, diverging from alar margin	as long rods, arcuate in x-section, separated by regularly spaced broad calcareous bridges dividing plate into laminae of equal width	dull orange internally	absent
H. leptoderma (Newman & Ross, 1971)	thin; inferior alar margin turning downward abruptly to form hook at free end; externally with fine growth ridges	as long., contiguous rods which form an almost continuous layer between inner and outer laminae; inner lamina and chitinous layer thin		yellow
H. nolearia (Foster, 1978)	narrow; inferior alar margin not curved, no basally directed hook at free end	as paired ribbons, situated inwards from grooves between ribs on inner surface of paries, dividing paries into thicker outer and thinner inner laminae		

Source : MNHN, Paris

H. persicum sp. nov.	ridged, increasing in width toward free end; inferior alar margin curved, with blunt, basally directed hook at free end	as chitinous rods, separating paries into inner (1/3) and outer (2/3) laminae	peachy-orange	ochre/yellow epidermis on scutum
H. sandaracum sp. nov.	narrow, ridged, serrated upper margin; inferior alar margin hollowed out, with blunt hook at free end; externally with widely spaced growth ridges	as lamina on inner surface of paries	orange (fresh material) or white	thin; colorless
H. triderma (Newman & Ross, 1971)	broad; inferior alar margin with abrupt, basally directed hook at free end; externally with strongly marked growth ridges	paries separated into 2 equal laminae by thin, almost continuous chitinous layer, of laterally elongate rods of chitin, straight in x-section, infrequently connected by small, inconspicuous calcareous bridges		brownish
H. velutinum Hoek, 1913	narrow, finely crenated; externally with parallel ridges	as lamina of orange chitin on inner surface of paries	white	velvety, thin; greyish

artic. = articular; b.-s. = basi-scutal angle; c.a. = caudal appendage; ext. = external; int. = internal; long. = longitudinal; n.a. = not applicable; proj. = projecting; segs = segments.

REMARKS. — Difficulties regarding the definition and familial placement of the deep-sea genera *Aaptolasma*, *Bathylasma* and *Hexelasma* were discussed by FOSTER (1978, 1981). Re-examination of the type material of *H. velutinum* led FOSTER (1981) to conclude that *Hexelasma* was a valid genus, but that *Aaptolasma* was a junior synonym of *Hexelasma*. FOSTER (1981) also described the new genus *Mesolasma* to accommodate *H. fosteri* (Newman & Ross, 1971). BUCKERIDGE (1983) included *Mesolasma* in the Bathylasmatinae.

HOEK (1913) established the genus *Hexelasma* but did not designate a type species. *Hexelasma velutinum* was designated as the type species of the genus by WITHERS (1913) and by subsequent selection by UTINOMI (1965) who, probably not realising that WITHERS (1913) had already designated a type species for *Hexelasma*, similarly designated *Hexelasma velutinum* as the type. FOSTER (1981) apparently also overlooked WITHERS' (1913) designation. BUCKERIDGE (1983) incorrectly listed *Balanus callistoderma* Pilsbry, 1911 as the type species of *Hexelasma*. *Balanus callistoderma* was the type species of *Aaptolasma* originally designated by NEWMAN and ROSS (1971).

Much confusion has stemmed from the fact that HOEK (1913) confounded more than 1 species in his description of *Hexelasma velutinum* — viz. *H. velutinum* s. str., *H. leptoderma* (Newman & Ross, 1971), and *H. arafurae* (Hoek, 1913). Of the 4 specimens originally included by HOEK (1913) in *H. velutinum*, 1 specimen had operculae which differed from those of the 2 specimens of *H. velutinum* (*"Siboga"*, stn 105) and the single specimen from *"Siboga"*, stn 251. This 'odd' specimen and its operculae were illustrated by HOEK (1913: 247, pl. 26 figs 3-5) and was later confirmed by FOSTER (1981) to be *H. leptoderma* Newman & Ross, 1971. FOSTER (1981) also determined that the parietal plates of *H. leptoderma* did not contain chitinous laminae, but that strips of orange chitin were present on the inner surface. The specimen from *"Siboga"*, stn 251 was attributed to *H. arafurae* by FOSTER (1981). The types of *H. velutinum* show no chitinous lamellae in the parietal shell, but do have a lamina applied basally to the inner faces of the shell plates. These specimens are considered immature since, in the further development of these laminae in larger specimens, calcite layers are found on either side of the laminae (FOSTER, 1981).

DISTRIBUTION. — Eocene to Recent. *Eocene*: Tonga; *Lower Miocene*: Victoria; *Recent*: Western Atlantic, Indo-west Pacific, 70-1300 m.

Off Florida, 734-770 m (*H. americanum*); Arafura Sea, 560 m (*H. arafurae*); Kei Is, 290 m (*H. leptoderma*); Vanuatu, New Caledonia, Loyalty Is, Norfolk Ridge, Wallis Is, Combe Bank, Field Bank, Tuscarora Bank, 170-1300 m (*Hexelasma sandaracum*); Chesterfield Is, Lord Howe Ridge, New Caledonia, Loyalty Ridge, Norfolk Ridge, 257-730 m (*H. aureolum*); New Caledonia, Loyalty Is, Norfolk Ridge, 255-608 m (*H. flavidum*); New Caledonia, Loyalty Is, Norfolk Ridge, 275-585 m (*H. persicum*); New Caledonia, Loyalty Is, 370-575 m (*H. globosum*); Vanuatu, Loyalty Is, 270-500 m (*H. foratum*); New Zealand, 741 m (*H. nolearia*); New Zealand, 1024-1029 m (*H. gracilis*); Japan, 115-141 m (*H. callistoderma);* Japan, 549 m (*H. triderma*); Japan, Philippines to South China Sea, 204-390 m (*H. velutinum*); Vietnam, 110-198 m (*H. brintoni*).

Source : MNHN, Paris

TABLE 31. — *Hexelasma*: maximum size, geographical and bathymetrical distribution of the species

	size (max.)	distribution	depth
H. americanum Pilsbry, 1916	RC length 17.0 C height 21.0	off Florida	734-770 m
H. arafurae Hoek, 1913		Arafura Sea	560 m
H. aureolum sp. nov.	RC length 19.0 C height 18.0	Chesterfield Islands Lord Howe Ridge New Caledonia Loyalty Ridge Norfolk Ridge	500 m 500-580 m 500-530 m 257-420 m 470-730 m
H. brintoni (Newman & Ross, 1971)		S China Sea (Vietnam)	110-198 m
H. callistoderma Pilsbry, 1911		Japan	115-141 m
H. flavidum sp. nov.	RC length 10.0 C height 6.0	New Caledonia Loyalty Islands Norfolk Ridge	560-608 m 300 m 255-370 m
H. foratum sp. nov.	RC length 10.9 C height 4.4	Loyalty Islands	270-330 m
H. globosum sp. nov.	RC length 12.5 C height 14.0	New Caledonia Loyalty Islands	525-575 m 370-465 m
H. gracilis Foster, 1981		New Zealand	1024-1029 m
H. leptoderma (Newman & Ross, 1971)		Kei Islands, Indonesia	290 m
H. nolearia (Foster, 1978)		New Zealand	741 m
H. persicum sp. nov.	RC length 19.4 C height 16.9	New Caledonia Loyalty Islands Norfolk Ridge	300-585 m 400-515 m 275-535 m
H. sandaracum sp. nov.	RC length 33.0 C height 27.02	Vanuatu New Caledonia Loyalty Islands Norfolk Ridge Combe Bank Wallis Islands Tuscarora Bank Field Bank	344-1220 m 170-960 m 270-680 m 300-540 m 700-1300 m 360-765 m 547-552 m 510-600 m
H. triderma (Newman & Ross, 1971)	RC length 19.5 C height 12.0	Japan	549 m
H. velutinum Hoek, 1913	RC length 10.0 C height 13.0	Japan Philippines to S China Sea	204-390 m

Hexelasma americanum Pilsbry, 1916

Fig. 51; Tables 28-31

Hexelasma americanum Pilsbry, 1916: 330, fig. 98, pl. 69 figs 1-3 a. — UTINOMI, 1965: 12. — NEWMAN & ROSS, 1976: 46. — FOSTER, 1981: 356. — YOUNG, 1998: 66, figs 1, 20-21.
Aaptolasma americanum - NEWMAN & ROSS, 1971: 161, pls 32 A-B, 36, 37. — FOSTER, 1978: 79.

MATERIAL EXAMINED. — **United States**. *"Albatross"*: stn 2663, off E coast of Florida, 29°39'N, 79°49'W, 770 m, 04.04.1886: holotype (USNM Type 14559).

TYPES. — *Holotype*: USNM 14559; United States, off S Carolina, *"Albatross"* stn 2663, 29°39'N, 79°49'W, 770 m, 04.04.1886, bottom temperature 42.7°F, seated on a branch of coral; complete specimen, dry.

Source : MNHN, Paris

Paratype: USNM 48093, from *"Albatross"*, stns 2662-3-9, 2671-2; remains of 3 individuals.
Holotype and paratype depository: USNM.

DIAGNOSIS. — Paries with longitudinal chitin-filled tubes, sub-arcuate in cross-section, regularly spaced, separated from one another by pronounced calcareous bridges. Basal width of CL^2 1/3 basal width of CL^1. Inferior alar margin not curved, with slight hook at free end; narrow welting along superior alar margin. Basis membranous, with narrowly inflected calcareous borders. S internally smooth; few crests for lateral depressor muscles present; externally smooth, regular growth lines not cut by longitudinal striae. T spur obliquely truncate, 1/3 width of basal margin, slightly removed from basi-scutal angle. Mandibular teeth acute, margins smooth.

REMARKS. — *Hexelasma americanum* is a large sized species (maximum: RC length 17.0, C height 21.0), with pale orange opercular plates.

DISTRIBUTION. — Off Florida, 734-770 m.

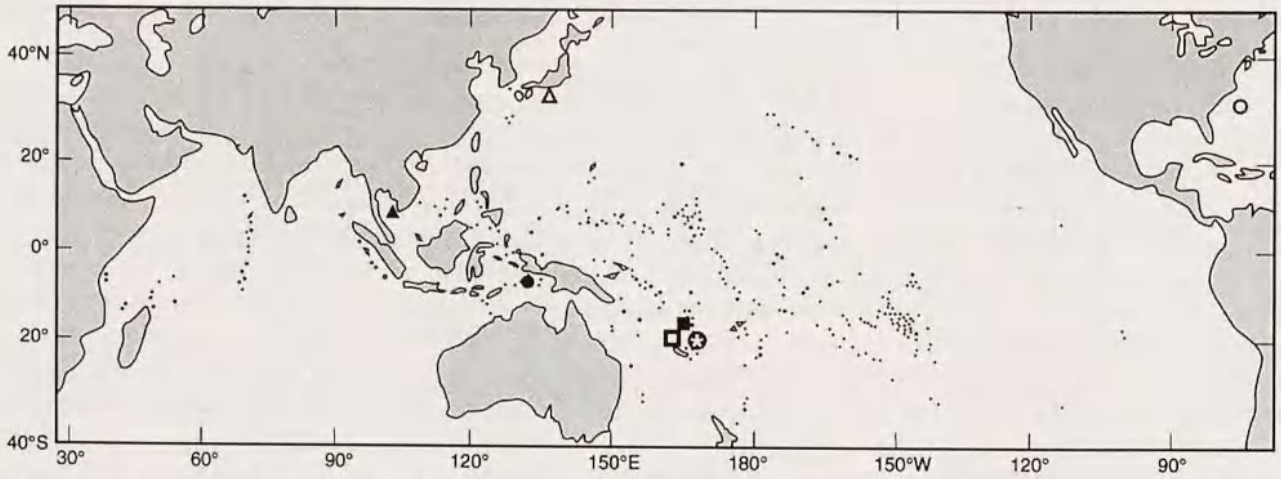

FIG. 51. — *Hexelasma* Hoek, 1913. Distribution map: ▲, *H. brintoni* (110-198 m); ○, *H. americanum* (734-770 m); △, *H. callistoderma* (115-141 m); ●, *H. arafurae* (560 m); □, *H. aureolum* (257-730 m); ■, *H. flavidum* (255-608 m); ✪, *H. foratum* (270-500 m).

Hexelasma arafurae Hoek, 1913

Fig. 51; Tables 28-31

Hexelasma arafurae Hoek, 1913: 251, pl. 25 figs 12-16. — UTINOMI, 1965: 11. — NEWMAN & ROSS, 1971: 155; 1976: 46. — FOSTER, 1981: figs 6 F-H.
Aaptolasma arafura - FOSTER, 1978: 79.

MATERIAL EXAMINED. — **Indonesia**. *"Siboga"*: stn 262, 5°53.8'S, 132°48.8'E, 560 m, 18.12.1899: holotype (ZMUA Cirr. 100.318).

TYPES. — *Holotype*: ZMUA Cirr. 100.318; Indonesia, *"Siboga"*, stn 262, 5°53.8'S, 132°48.8'E, 560 m, 18.12.1899, in alcohol.
Holotype depository: ZMUA.

DIAGNOSIS. — Continuous chitinous lamina bisecting thickness of parietal plates. Basal width of CL^2 more than 1/2 basal width of CL^1. Alae externally with strongly marked growth ridges; welting along superior alar margin inconspicuous. Basis calcareous, thin. S internal surface rough; crests for lateral depressor muscles present; externally smooth, even growth lines cut by a broad, longitudinal stria. T spur truncate, more than 1/3 width of basal margin, set almost at basi-scutal angle; inner surface smooth. Mandible with upper margins of teeth 3 and 4 with small subsidiary cusps.

Source : MNHN, Paris

REMARKS. — *Hexelasma arafurae* is a "large" species, with orange to brick-red orange opercular plates. The tall conical shell and the toothed orifice of *H. arafurae* are common to *H. aureolum* sp. nov., *H. callistoderma, H. persicum* sp. nov. and *H. velutinum*. Differences between *H. arafurae*, *H. aureolum* sp. nov. and *H. persicum* sp. nov. may be found under *H. aureolum* sp. nov. and *H. persicum* sp. nov., respectively.

Hexelasma callistoderma differs from *H. arafurae* as the former has parietal plates with longitudinal chitin-filled tubes, sub-arcuate in cross-section, separated from one another by regularly spaced, broad calcareous bridges; and the basal width of CL^2 is 1/4-1/5 the basal width of CL^1. In juvenile *H. callistoderma* the basis is membranous, adults having a thick calcareous ledge. The opercular plates of *H. callistoderma* are white. The S internal surface is smooth and externally the smooth, even growth lines are not cut by longitudinal striae. The T spur is roundly truncated, 1/4 the width of the basal margin, and set at 1/2 its own width from the basi-scutal angle; the inner surface is distally roughened in the carinal area above the muscle crests with linear beading. The mandible with no small subsidiary cusps.

H. velutinum is a large species (maximum: RC length 10.0, C height 13.0), with orange chitin applied to the inner surfaces of the parietal plates, which differs from *H. arafurae* as follows: the basal width of CL^2 is 2/3 the basal width of CL^1; the welting along the superior alar margin is narrow and finely crenated; the opercular plates are white; the S is convex externally, with smooth, widely-spaced, growth lines which are not cut by longitudinal striae; internally the adductor ridge is weak, crests for the lateral depressor muscles are absent; and the occludent and articular margins are rounded and folded; the T spur is set slightly apart from the basi-scutal angle; and the inner surface is roughened.

DISTRIBUTION. — Arafura Sea, 560 m.

Hexelasma aureolum sp. nov.

Figs 51-54; Tables 28-31

MATERIAL EXAMINED. — **Chesterfied Islands**. CORAIL 2: stn DE 16, 500 m: 2 specimens (WAM C 23253). — Stn CP 17, 500 m: 1 specimen.

Lord Howe Ridge. MUSORSTOM 5: stn DW 338, 540-580 m: 1 specimen (MNHN-Ci 2702). Drawn. — Stn CP 389, 500 m: 2 specimens (WAM C 23254, WAM C 23255).

New Caledonia. MUSORSTOM 4: stn DW 156, 525 m: 2 specimens. — Stn CP 238, 500-510 m: 1 specimen.

SMIB 8: stn DW 150, 519-530 m: 1 specimen.

Loyalty Ridge. MUSORSTOM 6: stn DW 422, 257 m: 1 specimen, attached to sponge. — Stn DW 460, 420 m: 1 specimen (incomplete) (WAM C 23256). — Stn DW 476, 300 m: 2 specimens, attached to stones (WAM C 23257). — Stn DW 478, 400 m: several specimens.

Norfolk Ridge. CHALCAL 2: stn DW 72, 527 m: 1 specimen, attached to sponge (MNHN-Ci 2411). — Stn DW 72, 527 m: 2 specimens, 1 attached to coral rubble, 1 to sponge (BMNH). — Stn DW 76, 470 m: 2 specimens.

SMIB 3: stn DW 5, 502-512 m: 1 specimen (MNHN-Ci 2412).

SMIB 4: stn DW 61, 550 m: 1 specimen, attached to coral.

BATHUS 3: stn DW 809, 650-730 m: 1 specimen. — Stn DW 819, 478-486 m: 1 specimen, attached to sponge (USNM).

TYPES. — *Holotype*: MNHN-Ci 2411 (CHALCAL 2, stn DW 72).

Paratypes: BMNH (CHALCAL 2, stn DW 72). — MNHN-Ci 2412 (SMIB 3, stn DW 5). — MNHN-Ci 2702 (MUSORSTOM 5, stn DW 338). Drawn. — USNM (BATHUS 3, stn CP 819). — WAM C 23253 (CORAIL 2, stn DE 16).

DIAGNOSIS. — Thin parietal plates with chitin either as lamina on inner walls of parietes, or as rods within paries separating paries into inner (1/4 thickness) and outer (3/4 thickness) lamina. Basal width of CL^2 1/4-1/3 basal width of CL^1; bases of plates thickened, forming calcareous ring. Inferior alar margin curved with slightly basally directed hook at free end; externally with fine, narrow growth ridges; narrow welting (sometimes inconspicuous) along superior alar margin. Basis calcareous, thin. Opercular plates whitish, apical areas of S and T pinkish orange-brown. S internal surface distally roughened with beading; crests for lateral depressor muscles

Source : MNHN, Paris

present; externally transverse, sinuous growth lines cut by 2 narrow, longitudinal striae. T spur truncate, 1/4 width of basal margin, set at its own width from basi-scutal angle; inner surface distally roughened with 6-9 low ridges and associated beading. Mandible with 1 small subsidiary tooth sometimes between teeth 3 and 4, lower margin of tooth 4 with 1 small subsidiary cusp.

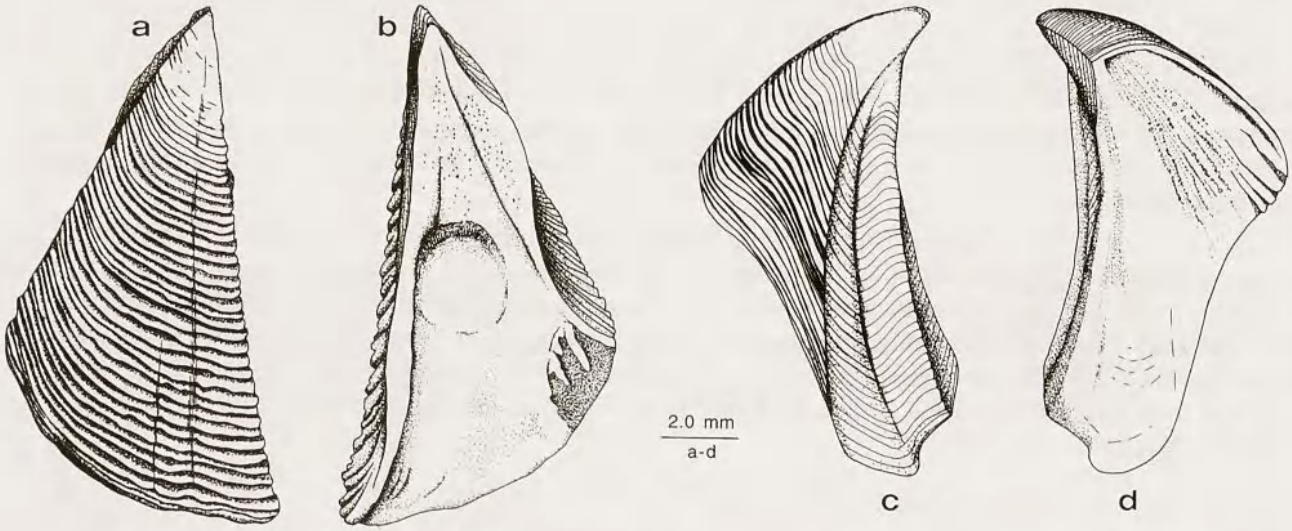

FIG. 52. — *Hexelasma aureolum* sp. nov. Paratype from MUSORSTOM 5, stn DW 338 (MNHN-Ci 2702): **a**, S, external view; **b**, S, internal view; **c**, T, external view; **d**, T, internal view.

DESCRIPTION. — Size large (maximum: RC length 19.0, C height 18.0). Shell conical, mature specimens tall. Parietal plates, thin (especially in juveniles), all plates sloping inward toward orifice except outwardly curving C; thick, golden yellow, persistent epicuticle covering paries; growth ridges definite, regular, narrow, marked by small golden setae; bases of paries thickened, forming calcareous rim; internally walls ribbed basally. Paries with yellow chitin, either as lamina on inner walls, or as rods within paries separating paries into inner (1/4 thickness) and outer (1/4 thickness) laminae. Rostral plate flattened, basal width greater than basal width of CL^1. CL^1 wider than CL^2; CL^2 narrow, elongated triangular shape, basal width 1/4 to 1/3 basal width of CL^1. C highest plate, not as wide as rostral plate; apex recurved outward. Alae with summits oblique; fine, narrow growth ridges directed upward parallel to inferior alar margin, then turning sharply downward toward alar angle, then upward again at sharp angle to form narrow welting, latter inconspicuous in some specimens; inferior alar margin curved, slightly basally directed hook at free end; alae visible externally for 3/4 (juvenile) to 2/3 (adult) length of parietes. Basis thin, calcareous. Orifice toothed, diameter smaller than that of basis; basis as wide as or wider than total height of shell. Opercular plates below level of orifice. S triangular, basal margin 9/14 length of occludent margin; apex acute; externally slight concavity in middle area; occludent margin longest margin, basal margin sinuous, shorter than articular margin, distinctly curved upward toward articular margin; sinuous growth ridges well defined, cut by 2 narrow, longitudinal ridges varying from slight to well marked, ridges not well separated, extending from apex to basal margin, ridge nearest occludent margin most well-marked; inner S surface with large, deep adductor muscle pit; adductor ridge weakly developed; lateral depressor muscle pit deep, with irregular muscle attachment crests; roughened, irregular ridges for attachment of rostral depressor muscle in deep pit; articular furrow deep; articular ridge extending almost 2/3 length of margin, slightly projecting; articular margin rounded, folded; inner surface of valve, including articular ridge, roughened with irregular beading distally. T smaller and narrower than S; externally sinuous growth ridges prominent; articular margin slightly concave; carinal margin convex; basal margin slightly hollowed, broad spur roundly truncated, 1/4 width of basal margin, set at its own width from basi-scutal angle; spur furrow open, basally shallow, broad; inner surface with articular ridge prominent in upper 1/3, not projecting; 4 well developed muscle attachment crests for depressor muscles; inner surface of valve roughened with

Source : MNHN, Paris

6-9 irregular, low ridges and associated beading in distal half. Parietal plates pale ochre/dirty lemon color, basally fading to whitish; alae whitish with lower areas peachy orange in young specimens. Opercular plates whitish; in some specimens apical areas of S and T pinkish orange-brown internally and externally. Measurements of holotype as follows:

MNHN-Ci	RC length	LD	C height	R height
2411	19.0	18.0	22.0	10.0

FIG. 53. — *Hexelasma aureolum* sp. nov. Holotype from CHALCAL 2, stn DW 72 (MNHN-Ci 2411): lateral view. Scale = 4 cm.

Labrum with shallow medial depression with row of small teeth and dense, short setae. Mandibular palp oblong-ovoid; long, finely serrate setae terminally. Mandible with 4 teeth, tooth 1 largest, well separated from teeth 2-4; with or without 1 small subsidiary cusp in angle between tooth 3 and 4; lower margin of tooth 4 with 1 small subsidiary cusp; inferior angle moderately large, molariform, with 2 protrusions, upper tooth-like, lower peg-like. Maxillule setose; 3 long, stout setae at upper angle; notch below upper angle wide, with 3-5 pairs of smaller setae; cutting margin below stepped, almost vertical, with 8-10 pairs of longer, stout setae; inferior angle not protuberant or stepped, barely demarked, with 5-7 pairs of smaller setae. Maxilla wide, coxal endite barely defined; setae long, finely serrulate.

Cirrus I with rami unequal; anterior ramus longer than posterior; proximal segments of anterior ramus not protuberant anteriorly, segments wider than posterior ramus; both rami with segments thickly setose, setae finely serrate. Cirrus II longer than cirrus I; rami unequal, anterior ramus shorter than posterior ramus; all segment, clothed with setae. Cirrus III similar to cirri IV-VI; rami subequal; segments becoming oblong distally; posterior ramus with 2-3 pairs of long, finely serrulate setae on anterior faces of distal segments, posterior segments densely setose; anterior ramus with 2 pairs of long, finely serrulate setae on anterior faces of distal segments, proximal segments with 3 pairs. Cirrus IV to VI similar, longer than cirrus III; rami subequal; segments oblong, with 3 pairs of long setae on anterior faces, distal 2 pairs of longest. Cirral formula as follows:

Paratype:		C I	C II	C III	C IV	C V	C VI
MNHN-	left	16, 13	15, 22	33, 38	41, 45	49, 51	55, 50
Ci 2702	right	14, 13	17, 22	32, 37	43, 49	49, 49	49, 51

Penis 1/2 length of cirrus VI; annulated; with few sparse setae; irregular circlet of longer setae distally.

REMARKS. — The tall conical shell and the toothed orifice are common to *H. aureolum* sp. nov., *H. arafurae*, *H. callistoderma* and *H. velutinum*. *Hexelasma aureolum* can be separated from *H. arafurae* as follows: in *H. aureolum* the basal width of CL^2 is 1/3 to 1/4 the basal width of CL^1, rather than being more than 1/2, and the alae are narrower and exposed for 2/3-3/4 the height of the wall, rather than wide and exposed for the total height of the wall, as in *H. arafurae*. In *H. aureolum* the chitin is either as a lamina applied on the inner surface of the paries, or as rods which separate the paries into inner (1/4 thickness) and outer (3/4 thickness) laminae; in *H. arafura* there is a continuous lamina of chitin bisecting the thickness of the parietal plates. The sinuous S growth lines of *H. aureolum* are cut by 2 narrow striae, those of *H. arafurae* are smooth and cut by 1 broad stria; the S basal margin of *H. aureolum* is distinctly curved upward toward the articular margin rather than being slightly rounded; and the S articular ridge is slightly, rather than not, projecting. In *H. aureolum* the T spur is 1/4 the width of the basal margin and set at its own width from the basi-scutal angle, rather than more than 1/3 of the

Source : MNHN, Paris

width of the basal margin and set almost at the basi-scutal angle; the inner surfaces of S and T are roughened with irregular beading distally, rather than being smooth, and are pale orange rather than brick-red. The cirral counts for *H. aureolum* are significantly higher than those for *H. arafurae* (CI 14, 13; CII 17, 22; CIII 32, 37; CIV 43, 49; CV 49, 49; CVI 49, 51 and CI 14, 10; CII 12, 15; CIII 19, 43; CIV 30, 37; CV 38, 40; CVI 39, 41, respectively).

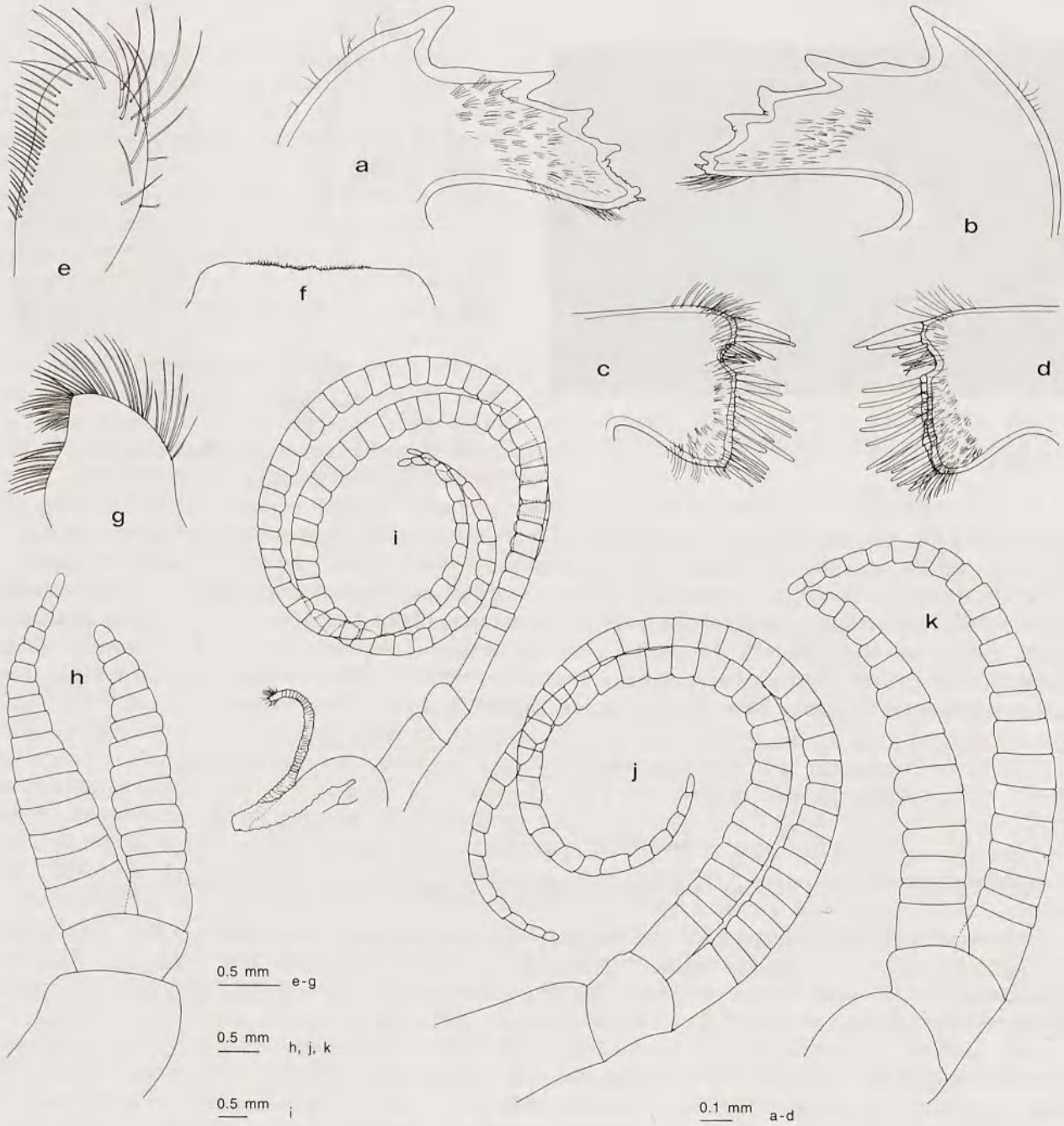

FIG. 54. — *Hexelasma aureolum* sp. nov. Paratype from MUSORSTOM 5, stn DW 338 (MNHN-Ci 2702): **a**, right mandible; **b**, left mandible; **c**, right maxillule, **d**, left maxillule; **e**, mandibular palp; **f**, labrum; **g**, maxilla; **h**, cirrus I; **i**, cirrus VI and penis; **j**, cirrus III; **k**, cirrus II.

Source : MNHN, Paris

Hexelasma aureolum is superficially similar to *H. callistoderma* but differs as follows: the basal width of CL^2 is 1/3 to 1/4 the basal width of CL^1, rather than 1/4 to 1/5 the width; the chitin is either as a lamina applied on the inner surface of the paries, or as rods which separate the paries into inner (1/4 thickness) and outer (3/4 thickness) laminae, rather than as long rods, sub-arcuate in cross section, separated by regularly spaced, broad calcareous bridges. The basis of *H. aureolum* is calcareous and thin; that of *H. callistoderma* is membranous in young specimens, with adults developing a thick calcareous ledge. In *H. aureolum* the T spur is set at a distance of its own width from the basi-scutal angle rather than 1/2 its width; and the inner surfaces of S and T are orange-brown in *H. aureolum,* white in *H. callistoderma.*

Hexelasma aureolum is superficially similar to *H. velutinum* but there are the following differences: in *H. aureolum* the basal width of CL^2 is 1/4 to 1/3 the basal width of CL^1, rather than 2/3 the width; the S adductor muscle pit is distinct rather than faint; the S articular ridge is slightly projecting, rather than not; the S depressor muscle pit is distinct rather than being a shallow excavation, the T basal margin is slightly hollowed out rather than straight; the T spur of *H. aureolum* is 1/4 the width of the basal margin and set at its own width from the basi-scutal angle, rather than 1/3 the width of the basal margin and set at 1/2 its own width from the basi-scutal angle; and the inner surface is roughened with 6-9 irregular, low ridges and associated beading in the distal half, rather than smooth. Cirral counts for *H. aureolum* are also higher than those for *H. velutinum* (CI 14, 13; CII 17, 22; CIII 32, 37; CIV 43, 49; CV 49, 49; CVI 49, 51 and CI 9, 13; CII 11, 14; CIII 22, 28; CIV 37, 39; CV 40, 43; CVI 42, 43, respectively).

ETYMOLOGY. — From the Latin *aureolum*, 'golden', referring to the golden color of the persistent epicuticle present on the compartmental plates.

DISTRIBUTION. — Chesterfield Islands, 500-580 m; New Caledonia, 500-530 m; Loyalty Ridge, 257-420 m; Norfolk Ridge, 470-730 m.

Hexelasma brintoni (Newman & Ross, 1971)

Fig. 51; Tables 28-31

Aaptolasma brintoni Newman & Ross, 1971: 162, fig. 78, pls 33 E-F, 38, 39 A-E; 1976: 46. — FOSTER, 1978: 79.
Hexelasma brintoni - FOSTER, 1981: 356.

MATERIAL EXAMINED. — **South China Sea**. NAGA EXPED. 1959-61: stn 97, 15°40.0'N, 109°22.9'E, 110-198 m, 27.02.1960: holotype (USNM Type No. 125311).

TYPES. — *Holotype*: USNM 125311; South China Sea, NAGA EXPED. 1959-61, stn 97, 15°40.0'N, 109°22.9'E, 110-198 m, 27.02.1960; dry (1 lot) and slides (3).
Holotype depository: USNM.

DIAGNOSIS. — Parietal plates with longitudinal chitin-filled tubes sub-arcuate in cross-section, regularly spaced, separated from one another by broad calcareous bridges; tubes bisecting thickness of parietal plates. Basal width of CL^2 3/5 basal width of CL^1. Inferior alar margin curved, without basally directed hook at free end; externally with weakly marked growth ridges; ridged, narrow welting along superior alar margin. Basis calcareous, thick. Opercular plates white. S internal surface smooth; several crests for lateral depressor muscles present; externally smooth, even growth lines not cut by longitudinal striae. T spur truncate, 1/3 width of basal margin, forming abrupt angle of 130° with basal margin, set at 1/2 its width from basi-scutal angle; inner surface smooth. Mandibular teeth 2 and 3 with side teeth, upper and lower margins of tooth 4 with small subsidiary cusps.

REMARKS. — *Hexelasma brintoni* is superficially similar to *H. flavidum* sp. nov., *H. foratum* sp. nov. and *H. sandaracum* sp. nov. Differences between *H. brintoni* and these species may be found under *H. flavidum* sp. nov., *H. foratum* sp. nov. and *H. sandaracum* sp. nov., respectively.

DISTRIBUTION. — Off Da Nang, Vietnam, 110-198 m.

Source : MNHN, Paris

Hexelasma callistoderma Pilsbry, 1911

Fig. 51; Tables 28-31

Balanus callistoderma Pilsbry, 1911: 78, fig. 10, pl. 12 fig. 5, pl. 15 figs 3-7.
Balanus corolliformis - KRÜGER, 1911: 55, figs 112-114, pl. 1 fig. 1, pl. 4 fig. 38.
Hexelasma callistoderma - HOEK, 1913: 245. — PILSBRY, 1916: 332, fig. 99. — UTINOMI, 1958: 307; 1965: 12. — FOSTER, 1981: 356.
Aaptolasma callistoderma - NEWMAN & ROSS, 1971: 159, fig. 77, pls 32 C-D, 35, 43 C; 1976: 46. — FOSTER, 1978: 79.

MATERIAL EXAMINED. — **Japan**. *"Albatross"*: stn 5068, off Ose Saki, 35°02'25"N, 138°46'55"E, 141 m, 15.10.1906: holotype (USNM Type 38690).

TYPES. — *Holotype*: USNM 38690; *"Albatross"* stn 5068, off Ose-Saki, Japan, 35°02'25"N, 138°46'55"E, 141 m, 15.10.1906.

Paratype: USNM 38690; *"Albatross"* stn 3741, Japan, about the same place than above, 115-124 m, 17.05.1900; in alcohol (1 lot), and slide (1).

Holotype and paratype depository: USNM.

DIAGNOSIS. — Parietal plates with longitudinal chitin-filled tubes, sub-arcuate in cross-section, separated from one another by regularly spaced, broad calcareous bridges. Basal width of CL^2 1/4-1/5 basal width of CL^1. External alar growth ridges fine; thin, rough welting along superior alar margin. Basis membranous (juveniles), adults with thick calcareous ledge. Opercular plates white. S internal surface smooth; crests for lateral depressor muscles present; externally smooth, even growth lines not cut by longitudinal striae. T spur roundly truncated, 1/4 width of basal margin, set at 1/2 its own width from basi-scutal angle; inner surface distally roughened in carinal area above muscle crests with linear beading. Mandibular teeth lacking small subsidiary cusps.

REMARKS. — *Hexelasma arafurae* and *H. aureolum* sp. nov are superficially similar to *H. callistoderma*. Differences between these species may be found under *H. arafurae* and *H aureolum* sp. nov., respectively.

DISTRIBUTION. — Japan, 115-141 m.

Hexelasma flavidum sp. nov.

Figs 51, 55-57; Tables 28-31

MATERIAL EXAMINED. — **New Caledonia**. BATHUS 4: stn CP 910, 560-608 m: 1 specimen (MNHN-Ci 2413).

Loyalty Islands. MUSORSTOM 6: stn DW 472, 300 m: several specimens, attached to sponges (MNHN-Ci 2703). Drawn. — Stn DW 472, 300 m: 2 specimens, 1 attached to sponge, 1 to coral rubble (WAM 257-96).

Norfolk Ridge. SMIB 5: stn DW 87, 370 m: 6 specimens, attached to coral rubble (MNHN-Ci 2414). — Stn DW 93, 255 m: 1 specimen, attached to live coral (*Corallium* sp.) (MNHN-Ci 2704).

TYPES. — *Holotype*: MNHN-Ci 2413 (BATHUS 4, stn CP 910).

Paratypes: MNHN-Ci 2414 (SMIB 5, stn DW 87). — MNHN-Ci 2703 (MUSORSTOM 6, stn DW 472). Drawn. — MNHN-Ci 2704 (SMIB 5, stn DW 93). — WAM 257-96 (MUSORSTOM 6, stn DW 472).

DIAGNOSIS. — Thin parietal plates with chitin present as lamina on inner walls of parietes between longitudinal ribs, or within paries as longitudinal tubes of chitin, separating paries into inner (1/4 thickness) and outer (3/4 thickness) lamina. Basal width of CL^2 1/3 or less than basal width of CL^1. Inferior alar margin curved, slight hook at free end; externally growth ridges well spaced; serrated, narrow, ridged welting along superior alar margin. Basis with calcareous edges, membranous centrally; thin. Opercular plates orange, apices cream. S internal surface smooth; crests for lateral depressor muscles slight; externally well-spaced, sinuous growth lines cut by slight longitudinal striae. T spur truncate, more than 1/3 width of basal margin, forming abrupt angle of 130° with basal margin, set at 1/4 its own width from basi-scutal angle; inner surface distally roughened. Mandible with upper and lower margins of tooth 4 with irregular, small subsidiary cusps.

Source : MNHN, Paris

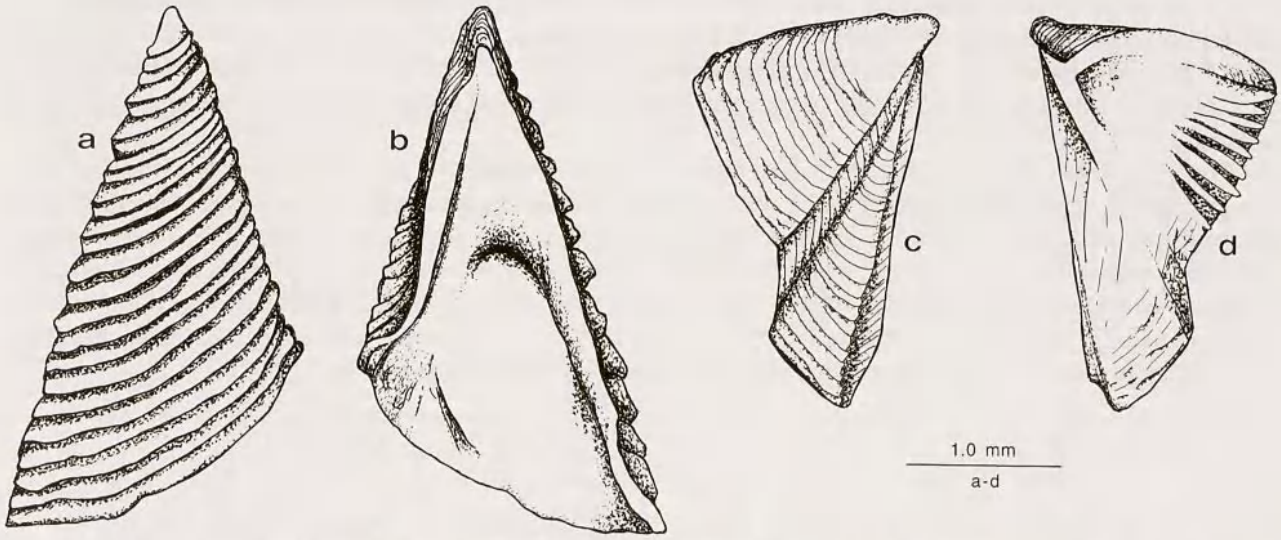

FIG. 55. — *Hexelasma flavidum* sp. nov. Paratype from MUSORSTOM 6, stn DW 472 (MNHN-Ci 2703): **a**. S, external; view; **b**, S, internal view; **c**, T, external view; **d**, T, internal view.

DESCRIPTION. — Size small (maximum: RC length 10.0, C height 6.0). Shell rounded, squat and flattened. Parietal plates thin, fragile; growth ridges faint, regular, finely beaded, lined with small, fine, golden setae, giving hirsute appearance; persistent epidermis absent; internally with longitudinal, low, spaced ribs extending 1/2 length of plates. Yellowish chitin applied either as lamina on inner surface of parietes, between longitudinal ribs, or as longitudinal tubes of chitin within plates, dividing thicker outer (3/4 width) and thinner inner (1/4 width) laminae. Rostral plate largest plate, convex; broad at base, height equal to height of C. Basal width of CL^2 1/3 or less than 1/3 basal width of CL^1. C larger than CL^1; distinctly shaped, central longitudinal ridge dividing plate into halves, ridge more distinct in juveniles, slight in adults. Superior alar margins sub-parallel to basis; growth ridges well spaced, directed upward parallel to inferior alar margin, then curving outward toward alar angle and upward again at sharp angle to form ridged welting, latter with serrated superior margin formed from wide spacing of growth ridges; inferior alar margin curved, slight hook at free end. Basis membranous centrally, calcareous at edges, thin. Orifice smaller in diameter than basis; opercular plates subparallel to basis. S thin, triangular, S basal margin 9/14 length of occludent margin, shorter than articular margin; occludent margin longest margin; externally sinuous growth ridges prominent, well spaced, cut by slightly indicated external longitudinal striae; internal surface smooth; adductor muscle and lateral depressor muscle pits shallow; adductor ridge weak; articular furrow shallow; articular ridge extending for 3/4 length of margin, not projecting; articular margin rounded, folded; S when closed filling aperture. T smaller than S; valve thin; externally growth ridges sinuous, less defined than S growth ridges; articular and carinal margins almost straight; basal margin hollowed out, meeting spur at sharp angle; spur basally truncated, more than 1/3 width of basal margin, forming abrupt angle of 130° with basal margin, set at 1/4 its own width from basi-scutal angle; spur furrow open, shallow, flat, broadest basally; internally articular ridge not projecting, traceable through 1/3 length of valve; 9 distinct, prominent muscle attachment crests for depressor muscles, slightly extending below basal margin; inner surface distally roughened. Parietal plates yellowish-orange with ochre yellow longitudinal tubes showing through thin parietal wall; alae yellowish-orange, welting whitish; opercular plates externally golden-orange with cream apices, orange/cream internally. Measurements of holotype as follows:

MNHN-Ci	RC length	LD	C height	R height
2413	10.0	9.5	6.0	5.7

Labrum with shallow medial depression with row of 30-35 bi- or tri-cusped teeth. Mandibular palp ovate; long, finely serrate setae terminally, plumose setae medially. Mandible with 4 teeth, tooth 1 largest, well separated from

Source : MNHN, Paris

2-4; margins of 1-3 smooth, upper and lower margins of 4 with irregular subsidiary cusps; inferior small, molariform, slightly dentate. Maxillule setose; 2 long, stout setae at upper angle; notch below upper angle wide, with 4 pairs of smaller setae; cutting margin below stepped, with 5 pairs of longer, stout setae; inferior angle not protuberant or stepped, with 4 pairs of small setae. Maxilla wide, coxal endite well developed; setae long, finely serrulate.

Cirrus I with rami subequal; anterior ramus slightly longer than posterior; proximal segments of anterior ramus not protuberant anteriorly, segments wider than those of posterior ramus; both rami with segments moderately setose. Cirrus II slightly longer than cirrus I; rami subequal; segments moderately setose, setae finely serrulate. Cirrus III longer than cirri I and II, and intermediate in form between cirrus II and cirrus IV; rami subequal; segments becoming oblong distally; anterior and posterior rami with 1-3 pairs of long, finely serrulate setae on anterior faces of distal segments. Cirrus IV to VI similar, longer than cirrus III; rami subequal; segments oblong, with 2 pairs of long, finely serrulate setae on anterior faces. Cirral formula as follows:

Paratype:		C I	C II	C III	C IV	C V	C VI
MNHN-	left	8, 6	8, 8	12, 15	20, 18	22, 18	22, 20
Ci 2703	right	8, 6	8, 7	12, 14	21, 23	20, 18	21, 21

Penis 1/2 length of cirrus VI; annulated; with few sparse setae; circlet of longer setae distally.

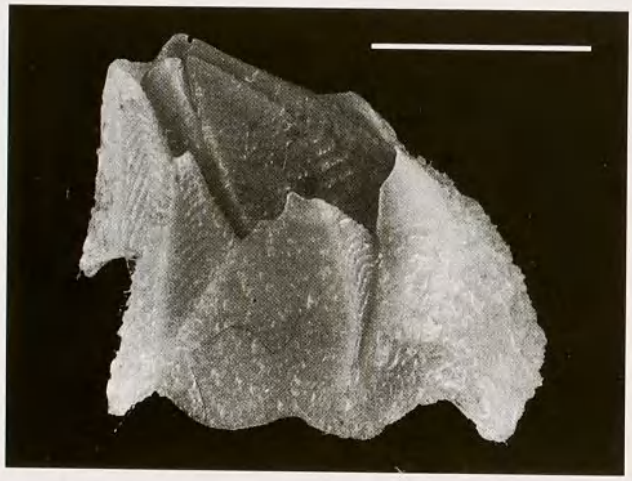

FIG. 56. — *Hexelasma flavidum* sp. nov. Holotype from BATHUS 4, stn CP 910 (MNHN-Ci 2413): lateral view. Scale = 5 mm.

REMARKS. — This species, with its wide, high alae and its low profile, is more similar to *H. brintoni, H. foratum* sp. nov. and *H. triderma* than to *H. callistoderma, H. americanum* or *H. leptoderma.*

Hexelasma flavidum sp. nov. can be separated from *H. brintoni* as follows: the shell is rounded, squat and flattened, rather than conical; the basal width of CL^2 is 1/3 or less than 1/3 the basal width of CL^1, rather than 3/5 the basal width; at the free end of the curved inferior alar margin a slight, basally directed hook is present, rather than absent; longitudinal tubes of chitin divide the paries into a thicker outer (3/4) and thinner inner (1/4) lamina, rather than into laminae of equal width; the basis is thin, calcareous at the periphery and membranous centrally, rather than thick and calcareous; the T spur is more than 1/3 the width of the tergal basal margin and set at 1/4 its own width from the basi-scutal angle, rather than 1/3 the width of the basal margin and set at 1/2 its width from the basi-scutal angle; the inner surface of T is roughened rather than smooth; and the color of S and T are orange-cream and not white. In addition the cirral counts are lower for *H. flavidum* than those for *H. brintoni.*

Hexelasma flavidum is distinguished from *H. triderma* by the following characters: the parietal plates are thin and relatively fragile, are without a persistent epidermis, and have faint, regular growth ridges lined with golden setae, in contrast to the robust, thicker plates of *H. triderma*, which are covered with a brownish cuticle marked by heavy, transverse growth ridges supporting numerous chitinous setae; the basal width of CL^2 is 1/3 or less than 1/3 the basal width of CL^1 in *H. flavidum*, in *H. triderma* 1/2-2/3. In *H. flavidum* longitudinal, chitin-filled tubes divide the paries into an outer (3/4 width) and thinner inner lamina (1/4 width), rather than an almost continuous sheet of chitin dividing the paries into an outer (2/3 width) and an inner lamina (1/3 width), as in *H. triderma.* The curved inferior alar margin of *H. flavidum* has a slight hook at its free end, rather than an abrupt, basally directed hook; and the basis of *H. flavidum* is thin, calcareous at the periphery and membranous centrally rather than thin, calcareous and marginally thickened (*H. triderma*). Opercular and soft parts are unknown for *H. triderma.*

Source : MNHN, Paris

Differences between *H. flavidum* and *H. foratum* sp. nov. are listed under *H. foratum* sp. nov.

ETYMOLOGY. — From the Latin *flavidum*, 'yellow', in reference to the distinctive yellow scuta of this species.

DISTRIBUTION. — New Caledonia, 560-608 m; Loyalty Islands, 300 m; Norfolk Ridge, 255-370 m.

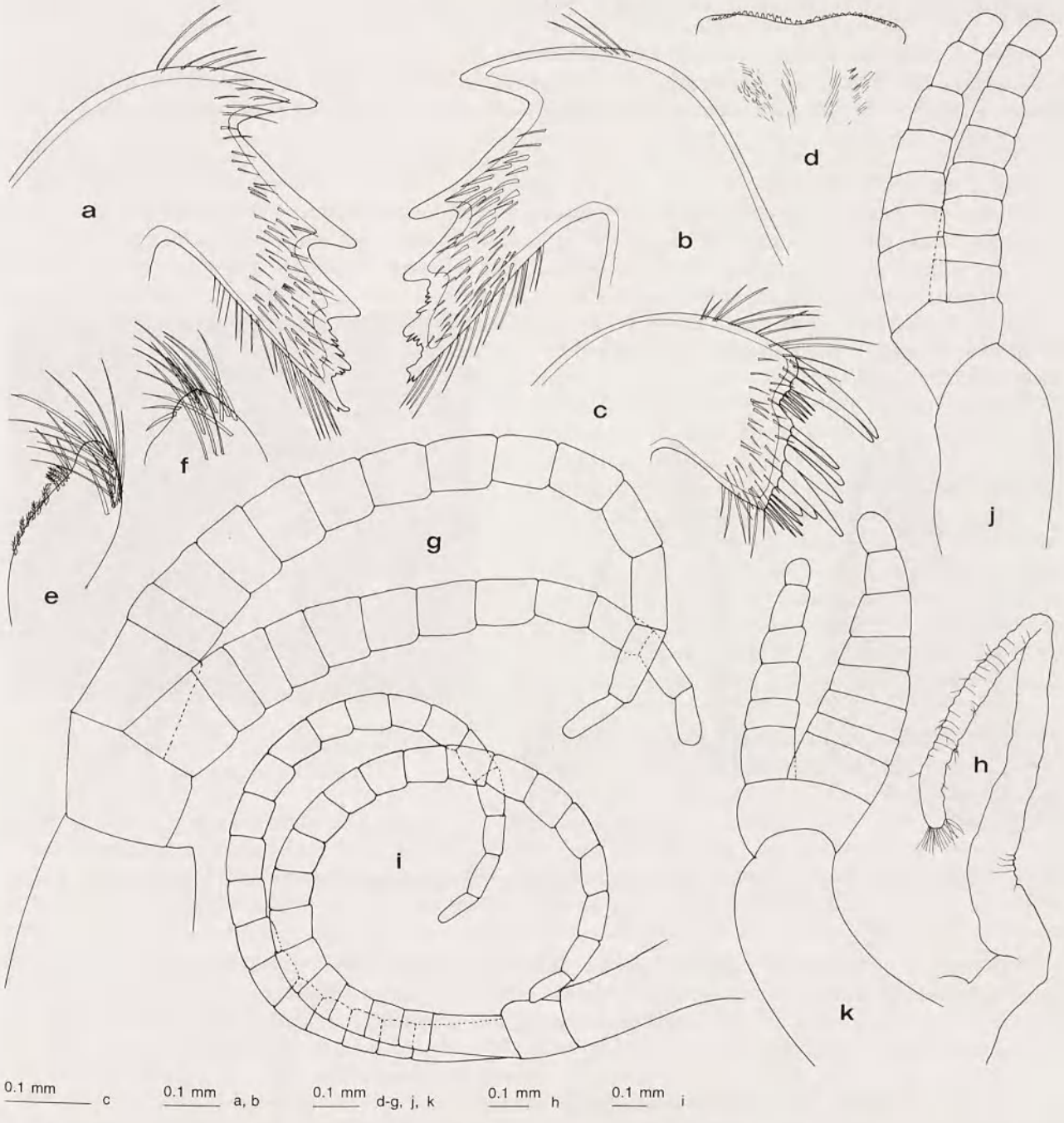

FIG 57. — *Hexelasma flavidum* sp. nov. Paratype from MUSORSTOM 6, stn DW 472 (MNHN-Ci 2703): **a**, right mandible; **b**, left mandible; **c**, right maxillule; **d**, labrum; **e**, mandibular palp; **f**, maxilla; **g**, cirrus III; **h**, penis; **i**, cirrus VI; **j**, cirrus II; **k**, cirrus I.

Source : MNHN, Paris

Hexelasma foratum sp. nov.

Figs 51, 58-60; Tables 28-31

MATERIAL EXAMINED. — **Loyalty Islands**. MUSORSTOM 6: stn DW 400, 270 m: 3 specimens (2 incomplete) (MNHN-Ci 2706, Ci 2707). — Stn DW 451, 330 m: 2 specimens (1 ovigerous, both incomplete) (MNHN-Ci 2415, Ci 2416). Drawn.

New Hebrides Arc. VOLSMAR: stn DW 16, 500 m: 1 specimen (WAM C 23258).

TYPES. — *Holotype*: MNHN-Ci 2707 (MUSORSTOM 6, stn DW 400).

Paratypes: MNHN-Ci 2415 (MUSORSTOM 6, stn DW 451). — MNHN-Ci 2416 (MUSORSTOM 6, stn DW 451). Drawn. — MNHN-Ci 2706 (MUSORSTOM 6, stn DW 400). — WAM C 23258 (VOLSMAR, stn DW 16).

DIAGNOSIS. — Thick parietal plates with chitin present as longitudinal, spaced rods, separating paries into equal sized laminae. Basal width of CL^2 1/4-1/3 basal width of CL^1. Inferior alar margin curved, without distinct hook at free end; narrow, ridged welting along superior alar margin, increasing in width toward free end. Basis calcareous, thick; minute, pinprick holes perforating junction of basis and inner surfaces of parietal plates. Opercular plates whitish. S internal surface roughened distally; crests for lateral depressor muscles absent; externally widely-spaced, sinuous growth lines not cut by longitudinal striae. T spur truncate, 3/10 width of basal margin, set at less than 1/2 its own width from basi-scutal angle; inner surface roughened over 2/3 of surface. Mandible with teeth 2 and 3 each with 1 small subsidiary cusp, upper and lower margins of tooth 4 with irregular, small subsidiary cusps.

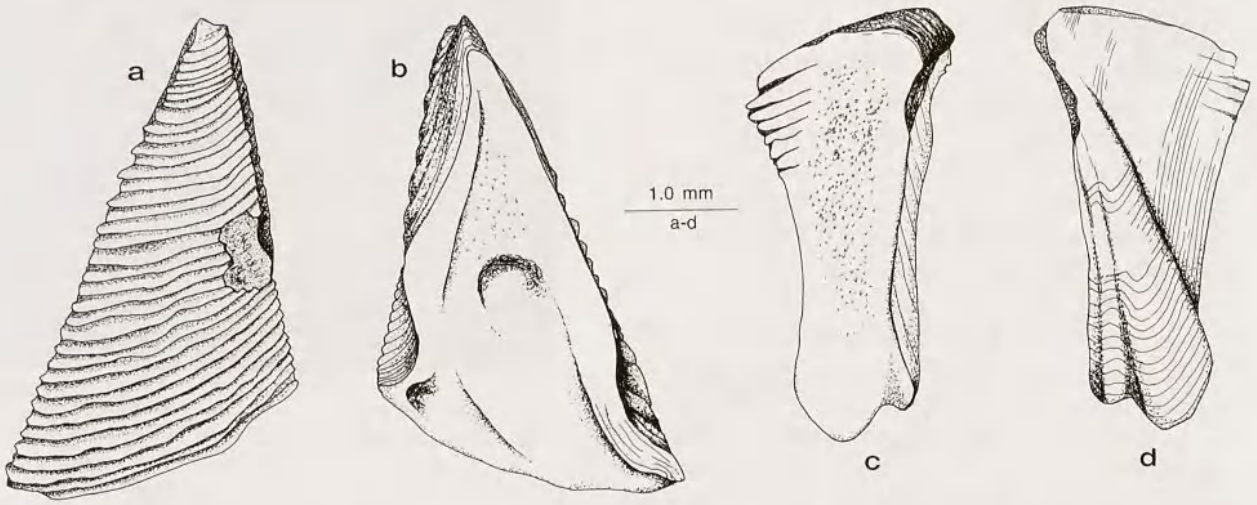

FIG. 58. — *Hexelasma foratum* sp. nov. Paratype (ovigerous) from MUSORSTOM 6, stn DW 451 (MNHN-Ci 2416): **a**, S, external view; **b**, S, internal view; **c**, T, internal view; **d**, T, external view.

DESCRIPTION. — Size small (maximum: RC length 10.9, C height 4.4). Shell truncated cone shaped. Parietal plates thick, rugged; externally with remains of yellow epidermis; fine growth ridges marked by long, golden, chitinous setae; basal margins of plates sometimes deeply fluted; longitudinal, spaced tubes of chitin in middle of parietal plates; inner surfaces of paries with faint indications of longitudinal ribs; minute, regularly spaced, pinprick holes perforating junction of basis and inner surfaces of parietal walls, holes corresponding to edges of longitudinal ribs. Rostral plate widest plate, flattened. Basal width of CL^1 less than basal width of rostral plate. Basal width of CL^2 1/4-1/3 basal width of primary CL^1. Carinal proportions similar to, but smaller than, those of rostral plate. Alae small; superior alar margins sub-parallel to basis; growth ridges directed upward, parallel to inferior alar margin, then curving outward toward alar angle and again upward at sharp angle to form narrow, ridged welting; inferior alar margin curved, without distinct hook at free end. Orifice small compared to basis; slightly

Source : MNHN, Paris

toothed. Basis sub-circular; calcareous, thick. S triangular, apex acute; sinuous basal margin 4/7 length of occludent margin; basal margin just shorter than straight articular margin; occludent margin longest margin; externally sinuous growth ridges prominent, wide, not cut by external longitudinal ridges; internally adductor muscle pit well defined, roughened area distally above adductor muscle pit; lateral depressor muscle pit deep, crests for lateral depressor muscles absent; adductor ridge feebly developed; articular ridge slightly projecting, extending 2/3 to 3/4 length of articular margin; articular margin rounded, slightly folded. T distinctly smaller than S; apex bluntly beaked; externally sinuous growth ridges less defined than those of S; articular margin slightly curved; carinal margin convex; basal margin slightly hollowed out; spur roundly truncated, rounded, 3/10 width of basal margin, set at less than 1/2 its own width from basi-scutal angle; spur furrow open, deep, flat; articular ridge not projecting, barely traceable; 6 prominent muscle attachment crests for depressor muscles not extending below basal margin; inner surface of valve roughened over 2/3 of surface. Color of parietal plates dirty white, S and T whitish externally and internally, S with golden yellow epidermis and golden, chitinous setae. Eggs orange. Approximate measurements of holotype as follows:

Holotype:	RC length	LD	C height	R height
MNHN-Ci 2707	10.9	10.7	4.4	3.9

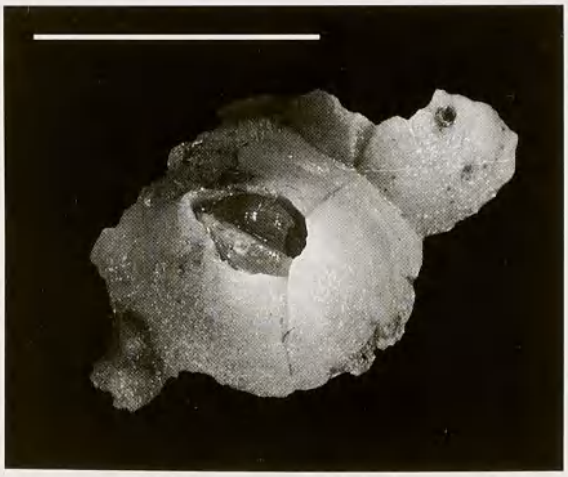

FIG. 59. — *Hexelasma foratum* sp. nov. Holotype from MUSORSTOM 6, stn DW 400 (MNHN-Ci 2707): oblique view. Scale = 1 cm.

Labrum with shallow medial depression, with fine small setae centrally and few small teeth on each side. Mandibular palp ovate; long, finely serrate setae terminally. Mandible with 4 teeth, tooth 1 largest, well separated from teeth 2-4; teeth 2 and 3 each with subsidiary small tooth; margins of teeth 1-3 smooth, upper and lower margins of 4 with irregular subsidiary cusps; inferior angle small, molariform, slightly dentate. Maxillule setose; 2 long, stout setae at upper angle; notch below upper angle wide, with 3-4 pairs of smaller setae; cutting margin below stepped, with 5-7 pairs of longer, stout setae; inferior angle not protuberant or stepped, with 4-5 pairs of small setae. Maxilla wide, coxal endite well developed; setae long, dense, finely serrulate.

Cirrus I with rami unequal; anterior ramus longer than posterior ramus; proximal segments of anterior ramus not protuberant anteriorly, segments wider than those of posterior ramus; both rami with segments moderately setose. Cirrus II longer than cirrus I; rami subequal; all segments moderately setose, setae finely serrulate. Cirrus III longer than cirri I and II and similar to cirri IV-VI; rami unequal, anterior ramus shorter than posterior ramus; segments of both rami becoming antenniform distally; posterior ramus with 2-3 pairs of long, finely serrulate setae on anterior faces of distal segments; anterior ramus with 2-3 pairs of long, finely serrulate setae on anterior faces of distal segments. Cirrus IV to VI similar, longer than cirrus III; rami subequal; segments oblong, with 2 pairs of long, serrulate setae on anterior faces. Chaetotaxy ctenopod. Cirral formula is as follows:

Paratype:		C I	C II	C III	C IV	C V	C VI
MNHN-	left	13, 7	10, 11	15, 19	21, 23	26, 28	29, 28
Ci 2416	right	13, 7	9, 11	15, 20	24, 26	29, 31	27, 29

Penis 1/3 length of cirrus VI; finely annulated; with few sparse setae; circlet of longer setae distally. Eggs large, rounded, 0.45 x 0.51 mm.

Source : MNHN, Paris

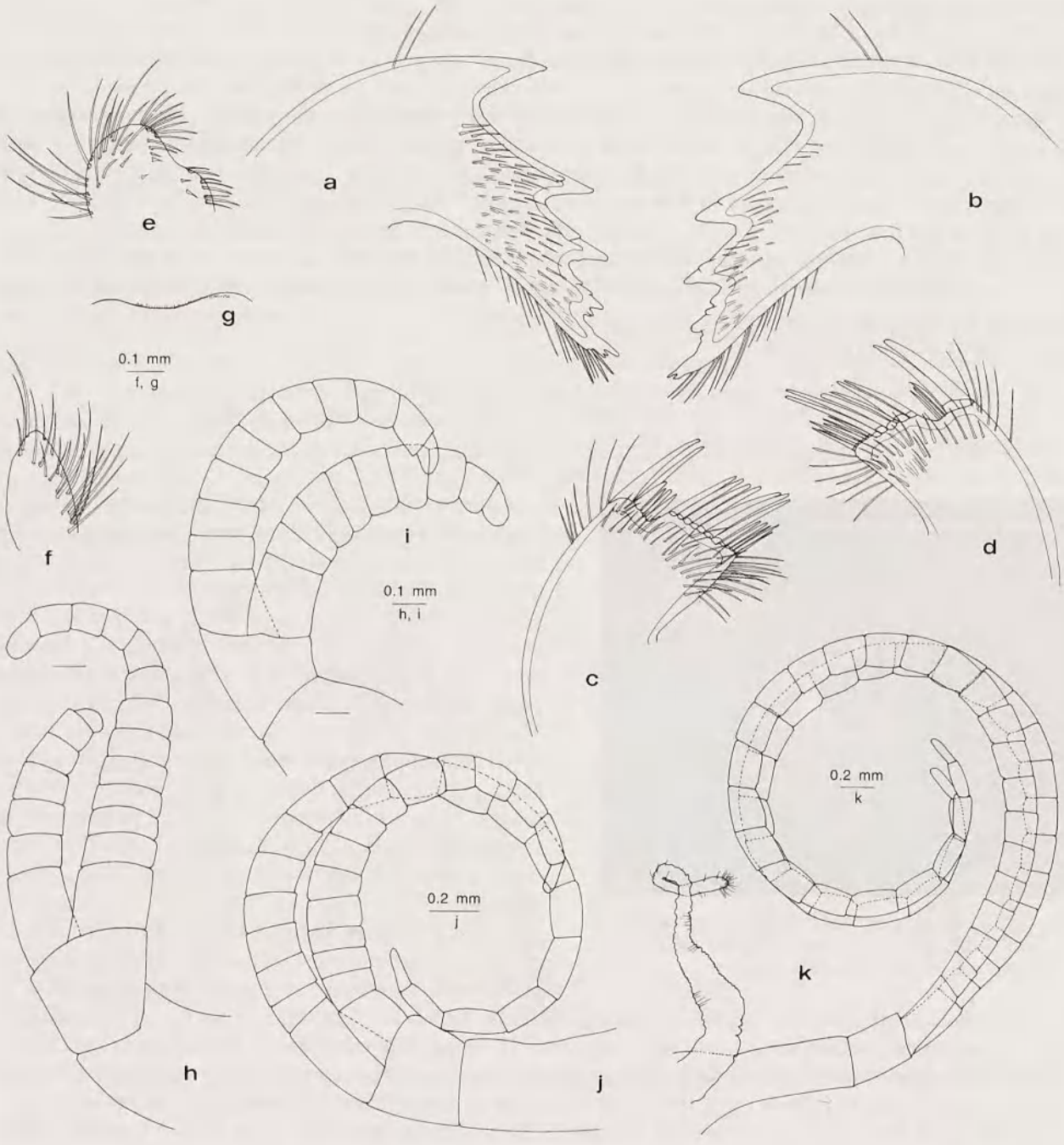

FIG. 60. — *Hexelasma foratum* sp. nov. Paratype (ovigerous) from MUSORSTOM 6, stn DW 451 (MNHN-Ci 2416): **a**, right mandible; **b**, left mandible; **c**, right maxillule; **d**, left maxillule; **e**, maxilla; **f**, mandibular palp; **g**, labrum; **h**, cirrus I; **i**, cirrus II; **j**, cirrus III; **k**, cirrus VI and penis.

REMARKS. — The minute pinprick holes, which correspond to the edges of the longitudinal ribs on the inner surface of the parietes, and which perforate the junction of the basis and the inner surfaces of the parietal plates, are unique structures not found in other hexelasmatines. *Hexelasma foratum* sp. nov., with its low profile and high alae nearly parallel to the basis, stands closer to *H. brintoni*, *H. triderma* and *H. flavidum* sp. nov. in form than to the other known members of the genus, where the alae are oblique.

Source : MNHN, Paris

Hexelasma foratum may be separated from *H. triderma* by the form of the chitin in the paries; in the former long, spaced rods of chitin bisect the thickness of the paries, in the latter the chitinous layer is developed as an almost continuous, thin sheet between the laminae which are about equal in thickness. In *H. foratum* the basal width of CL^2 is 1/4-1/3 the basal width of CL^1; in *H. triderma* the basal width of CL^2 is 1/2-2/3 the basal width of CL^1. The parietal plates of *H. foratum* are thick and rugged, externally fine growth ridges marked by long, golden, chitinous setae and with the remains of yellow epidermis; the robust, thicker plates of *H. triderma* are covered with a brownish cuticle marked by heavy, transverse growth ridges supporting numerous chitinous setae. In *H. foratum* the basis is calcareous and thick; in *H. triderma* it is thin, calcareous and marginally thickened. No opercular or soft parts are known for *H. triderma*.

The shape of *Hexelasma foratum* sp. nov. is a truncated cone; that of *H. flavidum* sp. nov. is rounded, squat and flattened. Longitudinal rods of chitin divide the paries into a thicker outer (3/4) and thinner inner (1/4) laminae in *H. flavidum*, and into laminae of equal width in *H. foratum*. In *H. foratum* the basal width of CL^2 is 1/4-1/3 the basal width of CL^1, and there is a yellow, persistent epidermis covering the parietal plates; in *H. flavidum* the basal width of CL^2 is 1/3 or less the basal width of CL^1 and a persistent epidermis is absent. The basis is thick and calcareous, with pinprick holes perforating the parietal/basal junction in *H. foratum*; that of *H. flavidum* is thin, calcareous at the periphery and membranous centrally, and perforations are absent. In *H. foratum* the S basal margin is 4/7 the length of the occludent margin, crests for the lateral depressor muscles are absent, the articular ridge is slightly projecting, and the inner surface is roughened distally. In *H. flavidum* the S basal margin is 9/14 the length of the occludent margin, slight crests for the lateral depressor muscles are present, the articular ridge is not projecting, and the inner surface is smooth. The T spur of *H. foratum* is 3/10 the width of the basal margin and set at 1/2 its own width from the basi-scutal angle; in *H. flavidum* it is 1/3 the width of the basal margin, set at 1/4 its width from the basi-scutal angle, and forms an abrupt angle of 130° with the basal margin. The color of S and T are whitish in *H. foratum*, orange-cream in *H. flavidum*.

Hexelasma foratum sp. nov. can be distinguished from *H. brintoni* as the basal width of CL^2 of the former is 1/4-1/3 the basal width of CL^1, rather than 3/5 the width. The basis is thick and calcareous, with pinprick holes perforating the parietal/basal junction in *H. foratum*; the basis is thick and calcareous, with no perforations in *H. brintoni*. The new species can be further separated by its low profile and truncated cone shape, compared to the conical form of *H. brintoni*. The T spur of *H. foratum* curves into the basal margin, rather than forming an abrupt angle of 130° with the basal margin, as in *H. brintoni*, and the T is internally roughened over 2/3 of the surface, rather than smooth. In *H. foratum* the S basal margin is 4/7 the length of the occludent margin, the internal surface is roughened distally, crests for the lateral depressor muscles are absent and the articular ridge is slightly projecting. In *H. brintoni* the S basal margin is 2/3 the length of the occludent margin, the internal surface is smooth, there are several crests for the lateral depressor muscles, and the articular ridge is not projecting.

ETYMOLOGY. — From the Latin *foratum*, 'to perforate', in reference to the small pinprick holes, corresponding to edges of parietal tubes, which perforate the junction between the basis and the inner surface of the parietal walls.

DISTRIBUTION. — New Hebrides Arc, Loyalty Islands, 270-500 m.

Hexelasma globosum sp. nov.

Figs 61-64; Tables 28-31

MATERIAL EXAMINED. — **New Caledonia**. MUSORSTOM 4: stn DW 156, 525 m: 3 specimens. — Stn CP 167, 575 m: 6 specimens, attached to pumice and coral rubble (MNHN-Ci 2418). Drawn. — Stn CP 197, 550 m: 5 specimens (MNHN-Ci 2417, WAM 258-96).

Loyalty Islands. BIOCAL: stn CP 45, 430-465 m: 1 specimen.

MUSORSTOM 6: stn DW 486, 370 m: 2 specimens, attached to surface of sponge.

TYPES. — *Holotype*: MNHN-Ci 2417 (MUSORSTOM 4, stn CP 197).

Source : MNHN, Paris

Paratypes: MNHN-Ci 2418 (MUSORSTOM 4: stn CP 167). Drawn. — WAM 258-96 (MUSORSTOM 4, stn CP 197).

DIAGNOSIS. —Thin parietal plates with thin lamina of chitin developed in longitudinal strips on inner surface of paries; bases of plates slightly thickened to form rim. Basal width of CL^2 1/2 basal width of CL^1. Basis calcareous, thin. Inferior margin of alae curved with slightly basally directed hook at free end; externally growth ridges well spaced, marked by fine tubercles; ridged welting along superior alar margin, increasing in width toward free end. Opercular plates whitish. S internal surface smooth; crests for lateral depressor muscles absent; externally well-spaced, sinuous growth lines cut by 3 slight longitudinal striae, middle stria most marked. T spur truncate, 1/4 width of basal margin, set at distance of less than 1/2 its own width from basi-scutal angle; inner surface roughened over 2/3 of surface. Mandible with upper and lower margins of tooth 4 with irregular, small subsidiary cusps.

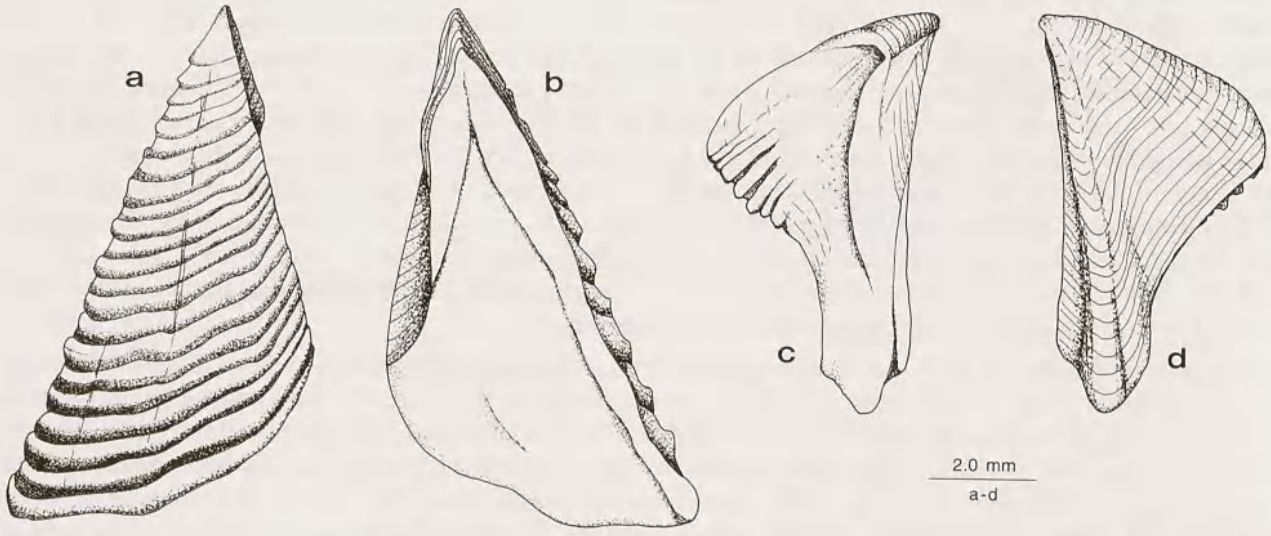

FIG. 61. — *Hexelasma globosum* sp. nov. Paratype from MUSORSTOM 4, stn CP 167 (MNHN-Ci 2418): **a**, S, external view; **b**, S, internal view; **c**, T, internal view; **d**, T, external view.

DESCRIPTION. — Size moderate (maximum: RC length 12.5, C height 14.0). Shell form globose or sub globose; rostral plate, CL^1 and CL^2 sloping inward toward orifice, C upright or sloping outward from orifice, apex slightly retroverted; opercular plates erect in orifice. Thin parietal plates; externally irregular, faint growth ridges defined by well spaced, small tubercles, and fine setae; bases of plates thickened to form rim. Thin lamina of chitin applied in longitudinal strips to inner surface of paries; bases of plates slightly thickened to form rim. Rostral plate wide, slightly convex. Basal width of CL^1 less than 1/2 basal width of rostral plate; basal width of CL^2 1/2 basal width of CL^1, narrow distally. C as wide as, but higher than, rostral plate; transversely bent, V-shaped from above. Alae of C and CL^2 well developed. Summits of alae oblique, especially those of C; growth ridges well spaced, marked by fine tubercles, directed upward parallel to inferior alar margin then curving outward and slightly downward to alar angle before upward again at sharp angle to form ridged welting, latter narrowing toward summit, widening toward alar angle; superior margin of welting serrate due to well spaced growth ridges; inferior margin of alae curved with hook slightly basally directed. Basis calcareous, thin. Orifice triangular; toothed; wider than basis. S triangular, apically acute; basal margin 2/3 length of occludent margin; occludent margin longest margin, basal margin longer than articular margin; externally sinuous growth ridges well spaced, cut by 3 slight longitudinal ridges in some specimens, shallow middle ridge most obvious; internal surface smooth; adductor and depressor muscle pits absent, crests for lateral depressor muscles absent; adductor ridge feeble, often visible only on 1 valve; articular furrow shallow; articular ridge extending 1/2 length valve, slightly projecting; occludent margin folded, articular margin deeply folded. T thin, smaller than S, apex bluntly beaked; externally sinuous growth ridges

Source : MNHN, Paris

strong; articular margin almost straight, carinal margin convex; basal margin hollowed out; spur narrow, truncated, 1/4 width of basal margin, set at distance of less than 1/2 its own width from basi-scutal angle; spur furrow open, shallow wide; internally articular ridge prominent in upper 1/4 of valve; 7 well developed depressor muscle attachment crests, slightly extending below basal margin; inner surface of valve distinctly roughened over 2/3 surface; articular ridge not projecting. Parietal plates whitish with yellow tinge; alae pale yellow; opercular plates whitish. Measurements of holotype as follows:

Holotype:	RC length	LD	C height	R height
MNHN-Ci 2417	12.5	12.0	14.0	9.8

FIG. 62. — *Hexelasma globosum* sp. nov. Holotype from MUSORSTOM 4, stn CP 197 (MNHN-Ci 2417): lateral view. Scale = 5 mm.

Medial depression of labrum with regular row of small teeth. Mandibular palp ovate; long, finely serrate setae terminally. Mandible with 4 teeth, tooth 1 largest, well separated from teeth 2-4; margins of teeth 1-3 smooth, upper and lower margins of 4 with irregular subsidiary cusps; inferior angle bluntly molariform, slightly dentate. Maxillule setose; 2 long, stout setae at upper angle; notch below upper angle wide, with 4-5 pairs of smaller setae; cutting margin below stepped, with 5-7 pairs of longer, stout setae; inferior angle slightly stepped, with 5-7 pairs of small setae. Maxilla wide, coxal endite well developed; setae long, dense, finely serrulate.

Cirrus I with rami unequal; anterior ramus slightly longer than posterior; proximal segments of anterior ramus not protuberant anteriorly, segments wider than posterior ramus; both rami with segments thickly setose. Cirrus II longer than cirrus I; rami subequal; all segments thickly setose, setae finely serrulate. Cirrus III longer than cirri I and II, similar to cirri IV-VI; rami subequal, segments slightly antenniform distally; anterior and posterior ramus with 1-2 pairs of long, finely serrulate setae on anterior faces of distal segments. Cirrus IV to VI similar, longer than cirrus III; segments oblong, with 2 pairs of long, serrulate setae on anterior faces. Cirral formula as follows:

Paratype:		C I	C II	C III	C IV	C V	C VI
MNHN-Ci	left	13, 10	12, 13	18, 27	33, 34	44, 47	44, 48
2418	right	11, 9	11, 13	12+, 17+	21+, 16	23+, 45	48, 48

Penis equal to length of proximal segment of pedicel of cirrus VI; finely annulated; with few sparse setae; irregular circlet of longer setae distally.

REMARKS. — *Hexelasma globosum* sp. nov. is similar to *H. leptoderma* but the form of the latter is conical and high with the orifice much smaller than the basis, rather than sub-globose with a large, triangular, toothed orifice which is wider than the basis. *Hexelasma leptoderma* has yellowish plates externally due to a persistent yellow epicuticle; there is no epicuticle associated with *H. globosum* and the plates are whitish with a yellow tinge. The alar growth ridges of *H. globosum* turn slightly downward before reaching the superior alar margin to form a slight hook, rather than turning abruptly downward, forming a definite hook. A thin lamina of chitin is developed in longitudinal strips on the inner surface of the parietal plates of *H. globosum*, rather than contiguous chitinous rods forming a continuous layer between the inner and the outer chitinous laminae. The S and T of *H. globosum* are not covered with a persistent yellow epidermis; the S and T of *H. leptoderma* are covered by

Source : MNHN, Paris

a persistent yellow epidermis. The T spur of *H. globosum* is truncated; that of *H. leptoderma* pointed. In *H. globosum* the scutal adductor muscle pit is not defined, rather than being distinct, the depressor muscle pits are absent rather than present, the adductor ridge is feebly developed, often on one valve only, rather than being developed on both plates, and the occludent and articular margins are deeply folded, rather than only the articular margin being slightly folded. The labrum of *H. globosum* has a medial depression with a regular row of approximately 70 small teeth, that of *H. leptoderma* has 42 teeth.

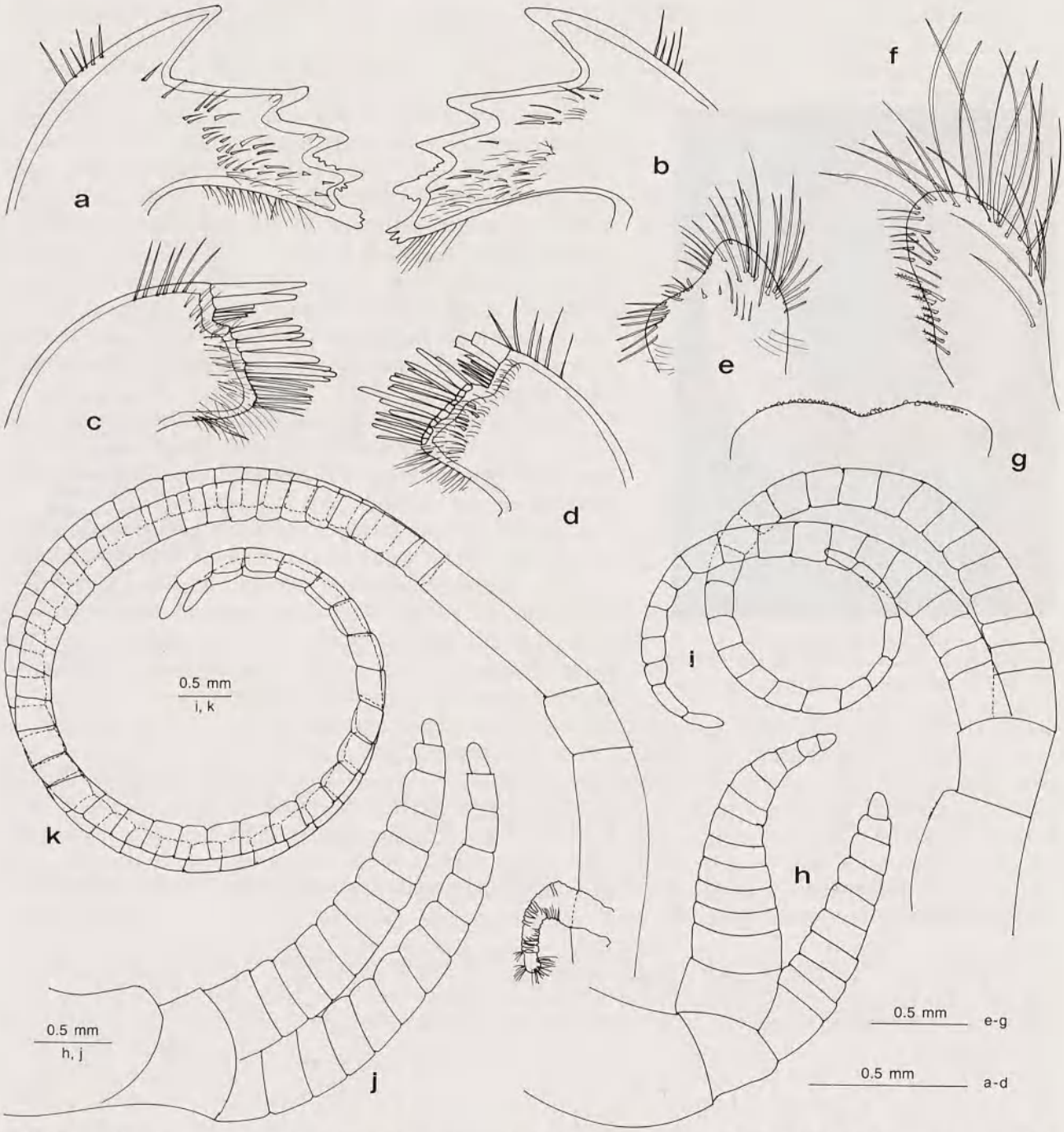

FIG. 63. — *Hexelasma globosum* sp. nov. Paratype from MUSORSTOM 4, stn CP 167 (MNHN-Ci 2418): **a**, right mandible; **b**, left mandible; **c**, right maxillule; **d**, left maxillule; **e**, maxilla; **f**, mandibular palp; **g**, labrum; **h**, cirrus I; **i**, cirrus III; **j**, cirrus II; **k**, cirrus VI and penis.

Source : MNHN, Paris

ETYMOLOGY. — From the Latin *globosus*, 'globose', in reference to the globular form of the shell.

DISTRIBUTION. — New Caledonia, 525-575 m; Loyalty Islands, 370-465 m.

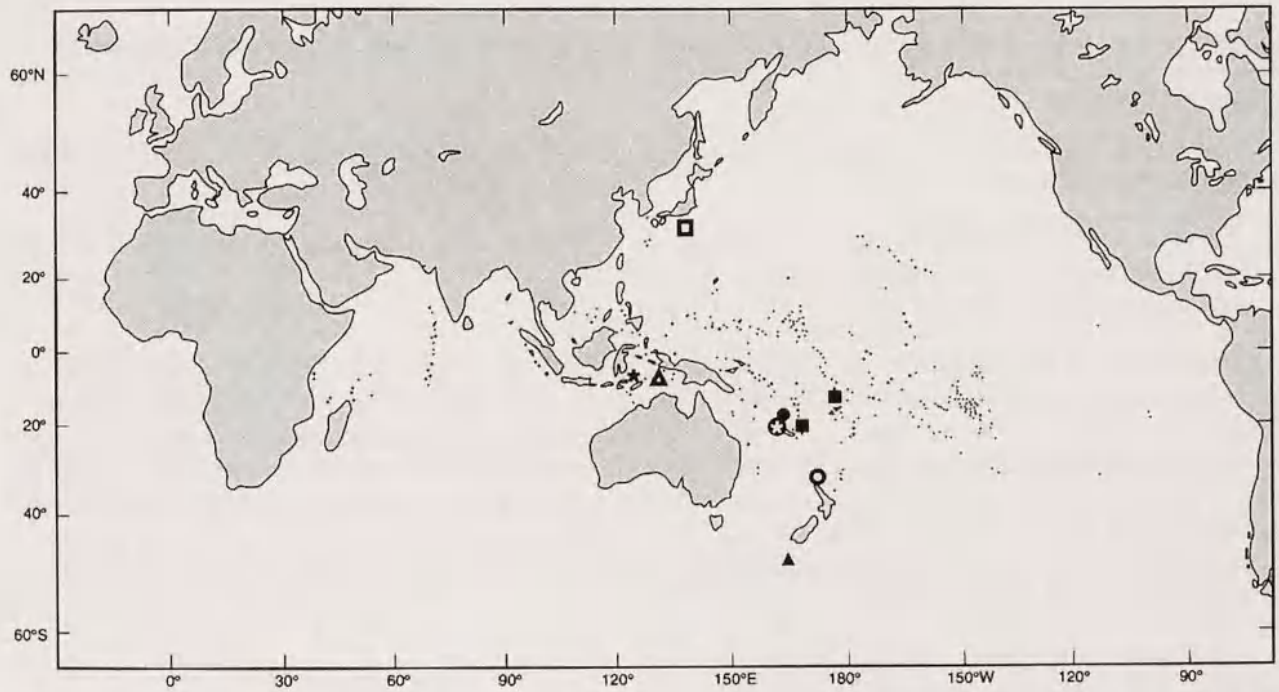

FIG. 64. — *HEXELASMA* Hoek, 1913 (continued). Distribution map: □, *H. triderma* (549 m); ★, *H. velutinum* (204-390 m); △, *H. leptoderma* (290 m); ✪, *H. globosum* (370-575 m); ●, *H. persicum* (275-585 m); ■, *H. sandaracum* (170-1300 m); ▲, *H. nolearia* (741 m); ○, *H. gracilis* (1024-1029 m).

Hexelasma gracilis Foster, 1981

Fig. 64; Tables 28-31

Hexelasma fosteri Foster, 1978: 83 (part).
Aaptolasma fosteri - FOSTER, 1978: (part), fig. 50, pl. 10 F.
Hexelasma gracilis Foster, 1981: 361.

MATERIAL EXAMINED. — **New Zealand**. NZOI: stn E 852, 33°38.00'S, 170°55.00'E, 1024-1029 m, 17.03.1968: holotype (NZOI Type H-357).

TYPES. — *Holotype*: NZOI H-357; New Zealand, NZOI stn E 852, 33°38.00'S, 170°55.00'E, 1024-1029 m, 17.03.1968.
Holotype depository: NIWA.

DIAGNOSIS. — Parietal plates with longitudinal chitin-filled tubes arcuate in cross-section, separated by regularly spaced, broad, calcareous bridges, dividing plate into laminae of equal width. Basal width of CL^2 subequal to basal width of CL^1. Alae externally with growth ridges well marked, narrow ridged welting along superior alar margin. Basis with wide calcareous ledge. Opercular plates internally dull orange. S internal surface smooth; crests for lateral depressor muscles faint; externally widely-spaced, sinuous growth lines not cut by longitudinal striae. T slender; spur rounded, 1/4 width of basal margin, set at 1/2 its own width from basi-scutal angle; inner surface smooth. Mandibular tooth 2 with side tooth.

DISTRIBUTION. — New Zealand, 1024-1029 m.

Source : MNHN, Paris

Hexelasma leptoderma (Newman & Ross, 1971)

Fig. 64; Tables 28-31

Aaptolasma leptoderma Newman & Ross, 1971: 165, figs 79-80, pls 33 A-B, 40; 1976: 46. — FOSTER, 1978: 79.
Hexelasma velutinum - BROCH, 1931: 53 (? part). ? non *Hexelasma velutinum* Hoek, 1913.
Hexelasma leptoderma - FOSTER, 1981: 356.

MATERIAL EXAMINED. — **Indonesia**. DANISH EXPED. 1922: stn 58, Kei Islands, 5°29'S, 132°37'E, 290 m, 12.05.1922: holotype (ZMUC Cru 1979).

TYPES. — *Holotype*: ZMUC Cru 1979; Indonesia, DANISH EXPED. 1922, stn. 58, Kei Islands, 5°29'S, 132°37'E, 290 m, 12.05.1922: 3 slides attached to brachiopod.
Holotype depository: ZMUC.

DIAGNOSIS. — Parietal plates with longitudinal chitin-filled tubes contiguous, forming almost continuous layer between inner and outer calcareous laminae, inner lamina and chitinous layer thin compared to the outer lamina. Basal width of CL^2 1/2 basal width of CL^1. Inferior margin of ala turning abruptly downward to form hook at free end; externally with fine growth ridges, thin welting along superior alar margin. Basis calcareous, thin. S internal surface roughened distally; crests for lateral depressor muscles present; externally widely-spaced, smooth growth lines not cut by longitudinal striae. T spur pointed, 1/4 width of basal margin, set at distance of 1/2 its own width from basi-scutal angle; inner surface roughened distally. Mandible with upper and lower margins of tooth 4 with small subsidiary cusps.

REMARKS. — *Hexelasma globosum* sp. nov. is similar to *H. leptoderma.* The differences between the 2 species are listed under *Hexelasma globosum* sp. nov.

DISTRIBUTION. — Kei Islands, 290 m.

Hexelasma nolearia (Foster, 1978)

Fig. 64; Tables 28-31

Aaptolasma nolearia Foster, 1978: 85, fig. 51, pl. 10 G-H.
Hexelasma nolearia - FOSTER, 1981: 356, 361.

MATERIAL EXAMINED. — **New Zealand**. NZOI: stn D159, 49°01.00'S, 164°30.00'E, 741 m, 17.01.1964: holotype (NZOI Type H-206).

TYPES. — *Holotype*: NZOI H-206; New Zealand, NZOI stn D 159, 49°01.00'S, 164°30.00'E, 741 m, 17.01.1964.
Holotype depository: NIWA.

DIAGNOSIS. — Parietal plates with pairs of chitinous ribbons, situated inward from grooves between prominent ribs of inner surface, dividing plates into thicker outer and thinner inner laminae. Basal width of CL^2 1/2 basal width of CL^1. Inferior margin of ala not curved, with no basally directed hook at free end; narrow welting along superior alar margin. Basis calcareous. S occludent and articular margins folded; internal surface smooth; faint crests for lateral depressor muscles; externally, well-spaced, smooth growth lines not cut by longitudinal striae. T articular margin convex; spur indistinct, 1/3 width of basal margin, set at basi-scutal angle; inner surface roughened distally. Mandible with upper and lower margins of teeth smooth.

DISTRIBUTION. — New Zealand, 741 m.

Source : MNHN, Paris

Hexelasma persicum sp. nov.

Figs 64-67; Tables 28-31

MATERIAL EXAMINED. — **Chesterfield Islands**. MUSORSTOM 5: stn DW 338, 540-580 m: 1 specimen (WAM 259-96).

New Caledonia. MUSORSTOM 4: stn DW 159, 585 m: 1 specimen, attached to stone. — Stn CP 179, 475 m: 1 specimen (BMNH). — Stn DW 197, 550 m: 1 specimen, attached to shell of gastropod (USNM). — Stn DW 222, 410-440 m: 1 specimen. — Stn DW 223, 545-560 m: 1 specimen.

BERYX 2: stn CP 46, 300-350 m: 2 specimens.

SMIB 8: stn CP 180, 425-460 m: 1 specimen. — Stn DW 185, 305-355 m: 1 specimen, 1 incomplete specimen. — Stn DW 193, 500-508 m: several specimens. — Stn DW 194, 491 m: 3 specimens.

BATHUS 4: stn DW 929, 502-516 m: several specimens.

Loyalty Islands. BIOCAL: stn DW 66, 505-515 m: 1 specimen, attached to coral.

MUSORSTOM 6: stn DW 478, 400 m: several specimens, some attached to sponge (MNHN-Ci 2419, Ci 2420). Drawn. — Stn DW 478, 400 m: 1 specimen, attached to rocks.

Norfolk Ridge. CHALCAL 2: stn CH 9, 300 m: 2 specimens, attached to sponge.

SMIB 4: stn DW 60, 535 m: 3 specimens.

SMIB 5: stn DW 94, 275 m: 2 specimens, attached to *Rhizotrochus* sp.

BATHUS 3: stn 818, 405-411 m: 2 specimens. — Stn CH 820, 394-401 m: 1 specimen, attached to gastropod shell. — Stn DW 830, 361-365 m: 2 specimens.

TYPES. — *Holotype*: MNHN-Ci 2419 (MUSORSTOM 6, stn DW 478).

Paratypes: BMNH (MUSORSTOM 4, stn CP 179). — MNHN-Ci 2420 (MUSORSTOM 6, stn DW 478). Drawn. — USNM (MUSORSTOM 4, stn DW 197). — WAM 259-96 (MUSORSTOM 5, stn DW 338).

DIAGNOSIS. — Parietal plates with chitinous rods separating parietes into inner (1/3 thickness) and outer (2/3 thickness) laminae. Basal width of CL^2 1/2 basal width of CL^1. Inferior margin of ala curved, with blunt, basally directed hook at free end; ridged welting along superior alar margin, increasing in width toward free end. Basis calcareous; thin. Opercular plates peachy-orange. S internal surface smooth; crests for lateral depressor muscles feeble or absent; externally sinuous, narrowly-spaced, growth lines cut by 3 faint longitudinal striae, 2 near occludent margin, 1 near articular margin. T spur truncate, 1/4 width of basal margin, set at distance of 1/3 its own width from basi-scutal angle; inner surface roughened distally. Mandibular tooth 2 with 1 or a few small subsidiary cusps, upper and lower margins of tooth 4 with small, irregular subsidiary cusps.

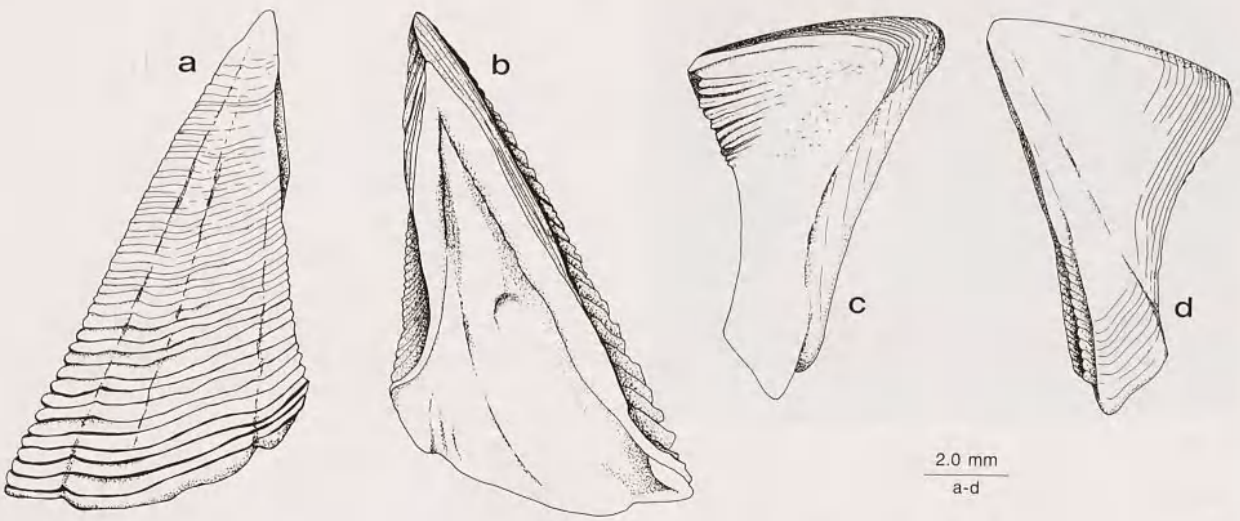

FIG. 65. — *Hexelasma persicum* sp. nov. Paratype from MUSORSTOM 6, stn DW 478 (MNHN-Ci 2420): **a**, S, external view; **b**, S, internal view; **c**, T, internal view; **d**, T, external view.

Source : MNHN, Paris

DESCRIPTION. — Size large (maximum: RC length 19.4, C height 16.9). Shell tall, nearly vertical. Parietal plates thick, covered by thin, pale cream, persistent epicuticle; growth ridges irregular, marked by small setae and minute calcareous knobs; basally inflected, forming thin rim; internally ribbed parietal walls with ribs prominent basally; chitinous rods separating parietes into inner (1/3 thickness) and outer (2/3 thickness) laminae. Rostral plate convex, wide basally; apex curving in toward orifice. Basal width of CL^1 1/2 basal width of rostral plate. Basal width of CL^2 1/2 basal width of CL^1; triangular. C highest plate; apex curving toward orifice. Alae wide, broadly triangular, extending full height of parietes; summits oblique; growth ridges directed upward parallel to inferior alar margin before curving downward and outward toward alar angle, then sharply upward to form ridged welting, increasing in width toward free end; inferior alar margin curved, with blunt, basally directed hook at free end. Orifice triangular; deeply toothed. Basis thin, calcareous. S triangular, elongated, apically sharply acute; occludent margin longer than other margins, basal margin 9/16 length of articular margin; externally with persistent ochre-yellow epidermis; sinuous growth ridges narrowly spaced, cut by 3 narrow, longitudinal ridges (some specimens with 1), 2 near to occludent margin, extending from apex to basal margin, 1 close to articular margin, traceable through 3/4 of valve, well-marked in lower half; basal margin sinuous, sometimes notched at bases of ridges; internally with indistinct, oval adductor muscle pit; adductor ridge feeble; lateral depressor muscle pit faint, feeble muscle attachment ridges on S; articular furrow shallow; articular ridge extending 2/3 margin, slightly projecting; articular and occludent margins rounded, folded, inner edges sinuous. T slightly smaller than S; apex blunt; externally sinuous growth ridges less defined than on S; articular margin straight/slightly convex; carinal margin straight; basal margin hollowed out; spur basally truncate, pointed toward and set close to basi-scutal angle; spur furrow open, slightly sunken, broad basally; internally with articular ridge not projecting; 7 distinct and 3 smaller muscle attachment crests for depressor muscles, not extending below basal margin; inner surface of valve lightly roughened with irregular beading in distal half. Color of parietal plates dirty white; cleaned specimens with some peachy-orange on parietes and alae. Apical and carinal areas of T often peachy-orange color internally and externally; remainder of valve whitish. Externally apical tip of S, and internally and externally central lower parts of valve tinged peachy-orange in some specimens, valve whitish elsewhere. Measurements of holotype as follows:

Holotype:	RC length	LD	C height	R height
MNHN-Ci 2419	19.4	14.2	16.9	14.6

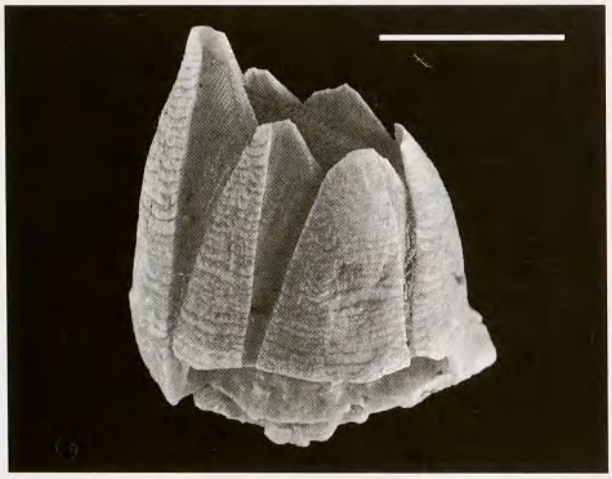

FIG. 66. — *Hexelasma persicum* sp. nov. Holotype from MUSORSTOM 6, stn DW 478 (MNHN-Ci 2419): lateral view. Scale = 1 cm.

Labrum with shallow medial depression provided with row of bifid teeth and dense, short setae. Mandibular palp ovoid; long, finely serrate setae terminally. Mandible with 4 teeth, tooth 1 largest, well separated from teeth 2-4; tooth 2 with 1 to several small subsidiary teeth, tooth 3 with 2 subsidiary teeth, tooth 4 with upper and lower margins irregularly dentate; inferior angle large, molariform, irregularly dentate. Maxillule setose; 2 long, stout setae at upper angle; notch below upper angle with 3-5 pairs of smaller setae; cutting margin below almost vertical, stepped, with 8-10 pairs of longer, stout setae; inferior angle barely delineated, with 4-6 pairs of smaller setae. Maxilla wide, coxal endite barely defined; area between basal and coxal endite with small spines; setae long, finely serrulate.

Cirrus I with rami unequal; anterior ramus longer than posterior; proximal segments of anterior ramus not protuberant anteriorly, segments wider than posterior ramus, becoming antenniform distally; both rami with

Source : MNHN, Paris

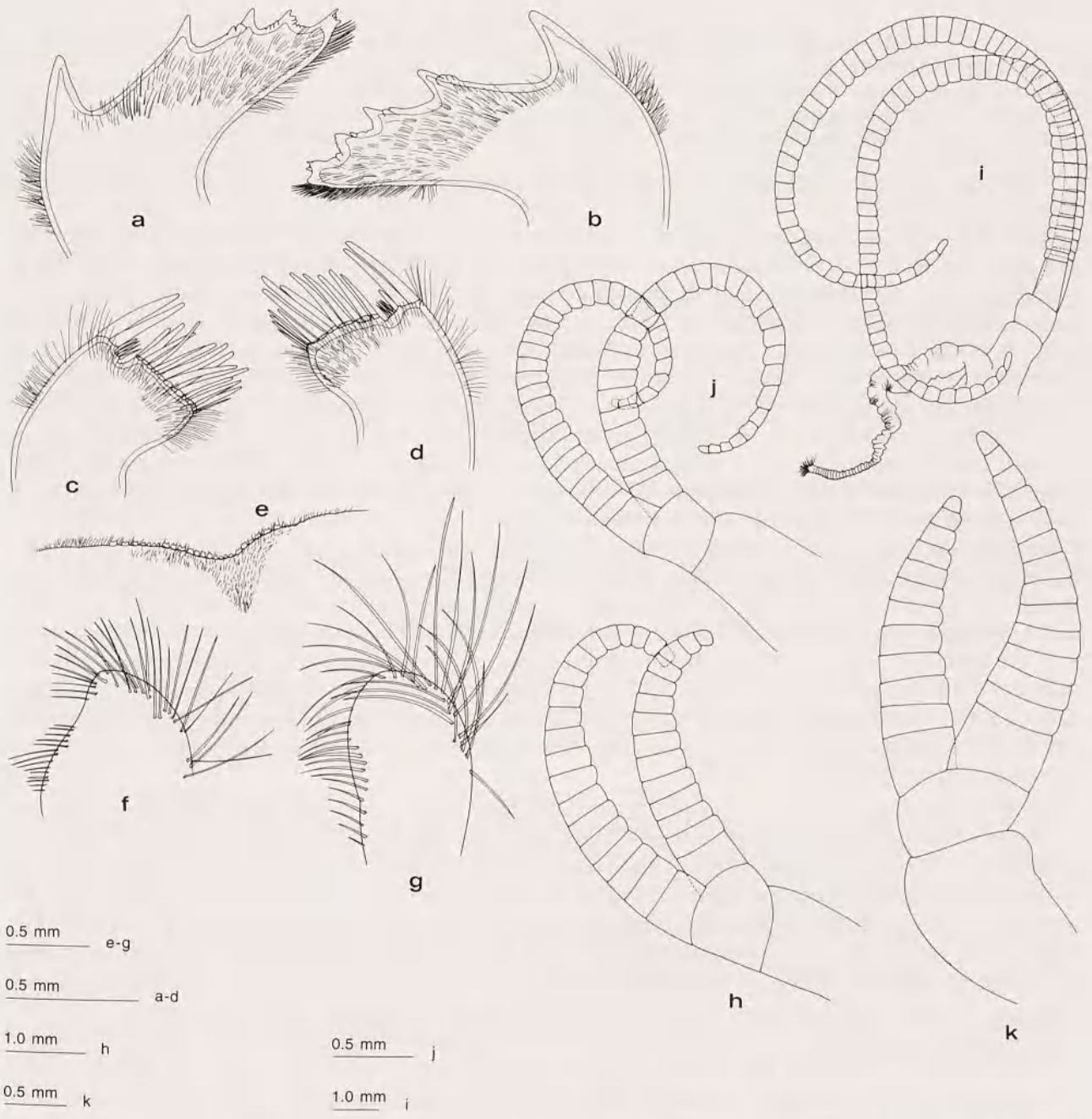

FIG. 67. — *Hexelasma persicum* sp. nov. Paratype from MUSORSTOM 6, stn DW 478 (MNHN-Ci 2420): **a**, right mandible; **b**, left mandible; **c**, right maxillule; **d**, left maxillule; **e**, labrum; **f**, maxilla; **g**, mandibular palp; **h**, cirrus II; **i**, cirrus VI and penis; **j**, cirrus III; **k**, cirrus I.

segments setose; setae finely serrulate distally. Cirrus II longer than cirrus I; rami unequal, posterior ramus longer than anterior ramus; all segments setose, especially proximally. Cirrus III much longer than cirri I and II and similar to cirri IV-VI; rami subequal, segments becoming oblong distally; anterior and posterior ramus with 2 pairs of long, finely serrulate setae on anterior faces of distal segments, proximal segments densely setose. Cirrus IV to VI similar, longer than cirrus III; rami subequal; segments oblong, with 2 pairs of long, finely

Source : MNHN, Paris

serrulate setae on anterior faces; proximal segments wider than long, becoming oblong distally. Cirral formula as follows:

Paratype:		C I	C II	C III	C IV	C V	C VI
MNHN-	left	15, 13	15, 24	35, 38	49, 52	56, 55	57, 58
Ci 2420	right	14, 12	14, 20	31, 33	41, 53	55, 61	56, 58

Penis 1/2 length of cirrus VI; annulated; with few sparse setae; irregular circlet of longer setae distally.

REMARKS. — *Hexelasma persicum* sp. nov. is similar to *H. arafurae* but differs by several characteristics of the hard parts. The shell of *H. persicum* is taller, more upright and with a more deeply toothed orifice than that of *H. arafurae*. In *H. persicum* chitinous rods separate the plates into inner (1/3 thickness) and outer (2/3 thickness) laminae, rather than a continuous chitinous lamina bisecting the thickness of the parietal plates as in *H. arafurae* (FOSTER, 1981). A persistent epicuticle covers the shell plates of *H. persicum* but is absent in *H. arafurae*. The basal width of CL^2 is 1/2 the basal width of CL^1 in *H. persicum* and more than 1/2 the basal width of CL^1 in *H. arafurae*. The welting of the alae of *H. persicum* is ridged, the welting increasing in width towards the free end; in *H. arafurae* the alae have strongly marked growth ridges, but the welting along the superior alar margin is inconspicuous. Externally the S of *H. persicum* has sinuous, narrowly spaced growth lines cut by 3 faint longitudinal striae, whilst that of *H. arafurae* has smooth, even lines cut by 1 broad, distinct longitudinal stria; and the S inner surface of *H. persicum* has an indistinct adductor muscle pit, rather than deep and distinct as in *H. arafurae*. The T spur of *H. persicum* is 1/4 the width of the basal margin, basally truncate and pointed toward the basi-scutal angle, rather than greater than 1/3 the width of the basal margin and basally rounded. In *H. persicum* the inner surface of T is lightly roughened with irregular beading, rather than smooth, and both S and T are colored peachy orange to white, rather than brick-red as in *H. arafurae*. There are also differences in the mouthparts and cirri. The labrum of *H. persicum* bears small teeth and setae centrally and small setae laterally, rather than small setae in the central region and small teeth laterally, and the cutting edge of the maxillule is distinctly, rather than barely, notched. Cirrus III of *H. persicum* has subequal rami, rather than the posterior ramus being antenniform and very much longer than the anterior ramus. The cirral counts for *H. persicum* are generally higher than those for *H. arafurae*, especially for cirri IV-VI.

FOSTER (1981) concluded that HOEK's (1913) specimen from *"Siboga"*, station 251 was *H. arafurae*, based on a continuous chitinous lamina, an inflected basal ledge and a thin calcareous basis. The elongated S was as in *H. arafurae* and cirral counts agreed better with *H. arafurae* than with the *H. velutinum* type specimens. However, the tergal spur differed from that figured by HOEK for *H. arafurae*, so ".... a definite conclusion about the synonymy must await further material and appreciation about the extent of variation." (FOSTER, 1981). The subtle yet consistent inter-specific variation found within the genus *Hexelasma*, indicated by the present study and alluded to by NEWMAN and ROSS (1971), further supports FOSTER's opinion.

ETYMOLOGY. — Named from the Latin *persicus*, 'peach-tree', in reference to the peachy-orange color on areas of the shell and opercular plates.

DISTRIBUTION. — Chesterfield Islands, 540-580 m; New Caledonia, 300-585 m; Loyalty Islands, 400-515 m; Norfolk Ridge, 275-535 m.

Hexelasma sandaracum sp. nov.

Figs 64, 68-70; Tables 28-31

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn CP 972, 487-507 m: 4 specimens. — Stn CP 973, 460-480 m: 7 specimens. — Stn CP 974, 492-520 m: many specimens (WAM 260-96). — Stn DW 978, 413-408 m: 7 specimens. — Stn DW 989, 650-669 m: 2 specimens. — Stn CP 1026, 437-504 m: 1 specimen. — Stn CP 1027, 550-571 m: 4 specimens. — Stn CP 1045, 459-488 m: many specimens. — Stn DW 1046, 461-480 m: 1 specimen. — Stn DW 1067, 344-366 m: 2 specimens. — Stn CP 1080, 799-850 m: 1 specimen. — Stn CP 1083, 397-439 m:

Source : MNHN, Paris

1 specimen. — Stn CP 1114, 647 m: 1 specimen. — Stn CP 1125, 1160-1220 m: many specimens.— Stn CP 1127, 1052-1058 m: 1 specimen. — Stn CP 1136, 398-400 m: 2 specimens.

New Caledonia. — LAGON: stn 491, 450 m: 1 specimen, attached to solitary coral.

MUSORSTOM 4: stn DW 156, 530 m: 5 specimens (3 adults, 2 juveniles). — Stn DW 156, 525 m: 4 specimens. — Stn DW 156, 525 m: 3 specimens. — Stn CP 157, 575 m: 3 specimens, attached to pumice and gastropod shells. — Stn DW 159, 585 m: 1 specimen, attached to rock. — Stn CP 167, 575 m: 2 specimens, attached to siliceous sponge. — Stn CP 169, 590 m: 2 specimens.— Stn CP 170, 480 m: 2 specimens (1 attached to gastropod shell). — Stn CP 178, 520 m: 1 specimen, attached to fragment of echinoderm test. — Stn CP 194, 545 m: 3 specimens (MNHN-Ci 2421, Ci 2705). Drawn; many specimens (MNHN-Ci 2422, BMNH, USNM). — Stn CP 197, 550 m: 5 specimens (1 free, 2 attached to dead coral, 2 attached to gastropod shells); 3 specimens (2 attached to dead coral, 1 to shell of gastropod).

BERYX 2: stn DW 34, 550-570 m: 1 specimen. — Stn DW 35, 550-570 m: 1 specimen. — Stn DW 38, 550-690 m: 2 specimens (dry), from shell.

SMIB 8: stn DW 189, 400-402 m: 2 specimens.

BATHUS 2: stn DW 729, 400 m: 1 specimen (dry), from shell.

BATHUS 4: stn CP 910, 560-608 m: 3 whole specimens; 2 incomplete specimens; 1 specimen (disarticulated). — Stn CP 911, 566-558 m: 2 specimens (dry), from shell; many specimens, attached to pumice and gastropod shells. — Stn DW 916, 600-616 m: 4 specimens, attached to dead coral rubble. — Stn DW 923, 470-502 m: many specimens, attached to dead coral rubble. — Stn DW 927, 452-444 m: 4 specimens, attached to dead coral rubble. — Stn DW 928, 420-452 m: 3 specimens (dry), from shell. — Stn CP 929, 502-516 m: 4 specimens; 1 specimen, attached to gastropod shell; 1 specimen (dry), broken, from shell. — Stn DW 932, 170-190 m: 1 specimen (juvenile). — Stn CP 951, 960 m: 1 specimen (disarticulated).

Loyalty Islands. BIOCAL: stn DW 36, 650-680 m: 2 specimens, attached to rock (WAM C 23259).

MUSORSTOM 6: stn CP 401, 270 m: 1 specimen. — Stn DW 424, 599 m: 1 specimen. — Stn CC 470, 560 m: 1 specimen, attached to stone. — Stn DW 471, 460 m: 2 specimens, attached to corals. — Stn DW 483, 600 m: 2 specimens, attached to rock.

Norfolk Ridge. SMIB 4: stn DW 44, 300 m: 1 specimen, attached to sponge. — Stn DW 62, 540 m: 2 specimens. — Stn DW 63, 520 m: 1 specimen, attached to dead coral. — Stn DW 64, 460 m: 4 specimens (2 adults, 2 juveniles).

BATHUS 3: stn CP 811, 383-408 m: 1 specimen (dry), broken, from shell.

Combe Bank. MUSORSTOM 7: stn DW 539, 700 m: 1 specimen. — Stn CP 622, 1280-1300 m: 1 specimen, attached to rock.

Wallis Islands. MUSORSTOM 7: stn DW 522, 650-765 m: 1 specimen, attached to rock. — Stn DW 522, 650-765 m: 1 specimen, attached to rock. — Stn DW 582, 360 m: 3 specimens, attached to rock.

Tuscarora Bank. MUSORSTOM 7: stn CP 559, 547-552 m: 4 specimens, 2 attached to rock.

Field Bank. MUSORSTOM 7: stn DW 586, 510-600 m: 1 specimen, attached to rock (WAM C 23260).

TYPES. — *Holotype*: MNHN-Ci 2421 (MUSORSTOM 4, stn CP 194).

Paratypes: BMNH (MUSORSTOM 4, stn CP 194). — MNHN-Ci 2422 (MUSORSTOM 4, stn CP 194). — MNHN-Ci 2705 (MUSORSTOM 4, stn CP 194). Drawn. — USNM (MUSORSTOM 4, stn CP 194). — WAM 260-96 (MUSORSTOM 8, stn CP 974).

DIAGNOSIS. — Thin parietal plates with inner surfaces covered with lamina of chitin. Basal width of CL^2 1/3-1/2 basal width of CL^1. Inferior margin of ala hollowed out, blunt tooth at free end; external surface with parallel growth ridges widely spaced; narrow, ridged welting, with serrated superior margin, serrations corresponding to spacing of growth ridges. Basis calcareous; thin. Opercular plates orange (fresh material) or white (preserved material). S internal surface smooth; low crests for lateral depressor muscles; externally sinuous, widely-spaced, growth lines cut by 3 longitudinal striae, 2 near occludent margin, 1 near articular margin; occludent and articular margins rounded, folded. T spur truncated, 1/4 width of basal margin, set at distance of 1/2 its own width from basi-scutal angle; inner surface slightly roughened in upper 1/2. Mandible with upper margin of tooth 3 with 1 or more small, subsidiary cusps, upper and lower margins of tooth 4 with small, irregular subsidiary cusps.

DESCRIPTION. — Size large (maximum: RC length 33.0, C height 27.0). Shell with paries erect, not curved inward toward C. Parietal plates thin; covered with colorless, thin, persistent epidermis; growth ridges well spaced; marked by fine, ochre setae and small tubercles; basal edges of plates irregularly toothed; inner surface of paries smooth, covered with lamina of chitin. Rostral plate convex, triangular; height subequal to C height, basal width greater than that of C. CL^1 with apex erect. Basal width of CL^2 1/2-1/3 basal width of CL^1; apex suberect. C strongly bent transversely, more pronounced toward apex with lateral halves meeting at precise angle. Alae wide, triangular, summits oblique; parallel growth ridges widely set, directed upward parallel to inferior alar margin

Source : MNHN, Paris

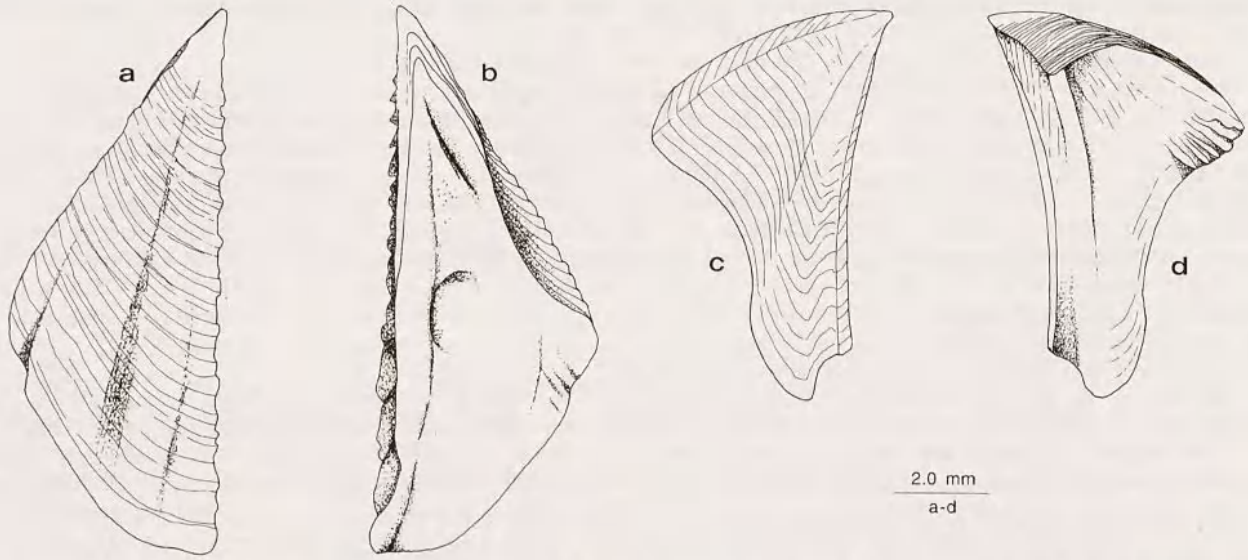

FIG. 68. — *Hexelasma sandaracum* sp. nov. Paratype from MUSORSTOM 4, stn CP 194 (MNHN-Ci 2705): **a**, S, external view; **b**, S, internal view; **c**, T, external view; **d**, T, internal view.

before curving outward and slightly downward toward alar angle and then up again at sharp angle to form narrow, ridged welting, with serrated upper margin, serrations corresponding to spacing of growth ridges; inferior alar margin hollowed out, blunt tooth at free end. Orifice pentagonal; toothed. Basis calcareous, thin, uneven; circumference circular. Opercular plates flush with orifice, inclined at angle to basis. S triangular, sharply pointed apically, externally gently concave in middle area; basal margin 9/15 length of occludent margin; occludent margin longest margin, basal margin slightly shorter than articular margin; sinuous growth ridges prominent, widely spaced, cut by 3 slight longitudinal striae (some specimens with 1), 2 near occludent margin, extending from apex to basal margin (stria nearest middle of valve shallower, longer than narrower stria nearest occludent margin), 1 near articular margin shallow, extending from apex for 2/3 length of valve; internally adductor muscle scar shallow, low lateral depressor muscle ridges in slight pit; adductor ridge feeble, often distinct on one S only; articular furrow shallow; articular ridge extending for 1/2 to 2/3 margin, slightly projecting; articular and occludent margins rounded, folded. T thin, distinctly smaller than S; apex beaked; externally sinuous growth ridges less defined than on S; articular margin slightly curved; carinal margin convex; basal margin weakly hollowed out; broad spur truncate, 1/4 width of basal margin, pointed toward and set at distance of 1/2 its width from basi-scutal angle; spur furrow open, shallow, flat, broad basally; articular ridge not projecting but traceable through 2/3 length of valve; 5-7 distinct depressor muscle crests, some slightly extending below basal margin; inner surface of valve slightly roughened in distal 1/2. Freshly preserved specimens with T vivid orange externally and internally in middle regions of valve; S similarly colored orange apically, externally and internally; C internally with sheath vivid orange, externally color suffusing through upper portions of C, including ala, through partly transparent paries; elsewhere paries externally pale lemon yellow; internally with yellow chitinous layer applied to inner faces. Long-preserved material with parietal plates externally creamy white-yellowish; summits of alae of C and CL^2 orange-tinged; internally parietes yellow; external and internal surfaces of S and T white. Eggs orange. Measurements of holotype and of largest specimen, respectively, as follows:

	RC length	LD	C height	R height
Holotype: MNHN-Ci 2421	16.2	14.6	13.2	10.9
Largest specimen	33.0	25.0	27.0	23.0

Shallow medial depression of labrum with row of well-developed teeth. Mandibular palp oblong; long, finely serrate setae terminally. Mandible with 4 teeth, tooth 1 largest, well separated from teeth 2-4; tooth 3 with 1 or

Source : MNHN, Paris

more small subsidiary cusps on upper margin, upper and lower margins of tooth 4 with irregular, small subsidiary cusps; inferior angle small, molariform, dentate. Maxillule setose; 3 long, stout setae at upper angle; notch below upper angle wide, with 4 pairs of smaller setae; cutting margin below stepped, sloping, with 7-10 pairs of longer, stout setae; inferior angle barely demarcated, with 4-6 pairs of smaller setae. Maxilla wide, coxal endite barely defined; setae long, finely serrulate.

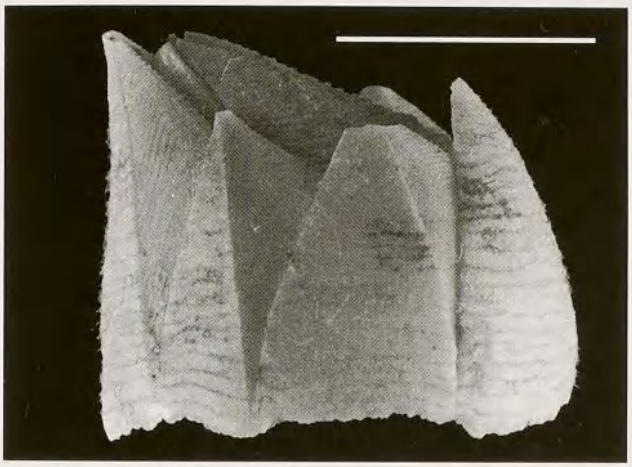

FIG. 69. — *Hexelasma sandaracum* sp. nov. Holotype from MUSORSTOM 4, stn CP 194 (MNHN-Ci 2421): lateral view. Scale = 1 cm.

Cirrus I with rami subequal; anterior ramus longer than posterior; proximal segments of anterior ramus not protuberant anteriorly, segments wider than posterior ramus; both rami with segments setose, setae finely serrulate distally. Cirrus II longer than cirrus I; rami subequal, all segments setose, setae finely serrulate. Cirrus III longer than cirri I and II and similar to cirri IV-VI; rami subequal, segments slightly antenniform distally; posterior ramus with 1-2 pairs of long, finely serrulate setae on anterior faces of more distal segments; anterior ramus with 2-3 pairs of long, finely serrulate setae on anterior faces of distal segments, proximal segments with 4 pairs of long setae. Cirrus IV to VI similar, longer than cirrus III; rami subequal; segments becoming oblong distally, with 2 pairs of finely serrulate, long setae on anterior faces. Cirral formula as follows:

Paratype:		C I	C II	C III	C IV	C V	C VI
MNHN-	left	13, 9	14, 18	19+, 39	37, 43	47, 48	47, 47
Ci 2705	right	13, 9	13, 16	20, 25	38, 43	33, 36	46, 46

Penis 1/4 length of cirrus VI; annulated; with few sparse setae; irregular circlet of longer setae distally. Large ellipsoidal eggs, few in number, 0.35 x 0.25 mm.

REMARKS. — *Hexelasma sandaracum* sp. nov. is similar to *H. brintoni* but the two can be separated on characters of the hard and soft parts. The basal width of CL^2 of *H. sandaracum* is 1/2-1/3 the basal width of CL^1 rather than 3/5 the basal width. In *H. sandaracum* the inferior alar margin is hollowed out, with a blunt, downwardly directed tooth at the free end, as opposed to curved and without a basally directed hook at the free end, as in *H. brintoni*. Chitin is present as a lamina on the inner surface of the paries in *H. sandaracum*. In *H. brintoni* the parietal plates have longitudinal, chitin-filled rods, sub-arcuate in cross-section, regularly spaced and separated from one another by broad calcareous bridges, which bisect the thickness of the parietal plates. The calcareous basis is thin in *H. sandaracum* and thick in *H. brintoni*. In *H. sandaracum* the tergal spur is 1/4 rather than 1/3 the width of the basal margin; and the tergal basal margin rounds into the spur, rather than meeting it at an abrupt angle as in *H. brintoni*. The S of *H. sandaracum* externally has sinuous growth lines cut by 3 longitudinal striae; that of *H. brintoni* has smooth, even growth lines not cut by longitudinal striae. In addition the cirral counts are higher for *H. sandaracum* than those for *H. brintoni*.

Hexelasma sandaracum sp. nov. is also similar to *H. triderma* but there are differences in the overall shell form. The opercular plates and soft parts of *H. triderma* are undescribed. In *H. sandaracum* the shell plates are covered with a colorless, thin, persistent epidermis, and the growth ridges are well spaced and marked by fine, ochre setae and small tubercles, rather than covered with brownish cuticle and marked by heavy transverse growth ridges with numerous setae. In *H. sandaracum* the alar welting is narrow rather than broad, and the inferior alar margin is hollowed out, with a blunt, downwardly directed tooth at the free end, rather than curved, with an abrupt, basally directed hook at the alar angle. The basal width of CL^2 of *H. sandaracum* is 1/2-1/3 the basal width of CL^1 rather than 1/2-2/3. Chitin is present as a yellow lamina on the inner surface of the paries in *H. sandaracum*, rather than

Source : MNHN, Paris

as a thin, chitinous layer formed by laterally elongate, longitudinal, chitin-filled tubes, nearly straight in cross-section, which separate the wall into equal sized inner and outer calcareous laminae, connected infrequently by small, inconspicuous calcareous bridges. Opercular and soft parts of *H. tridema* are unknown.

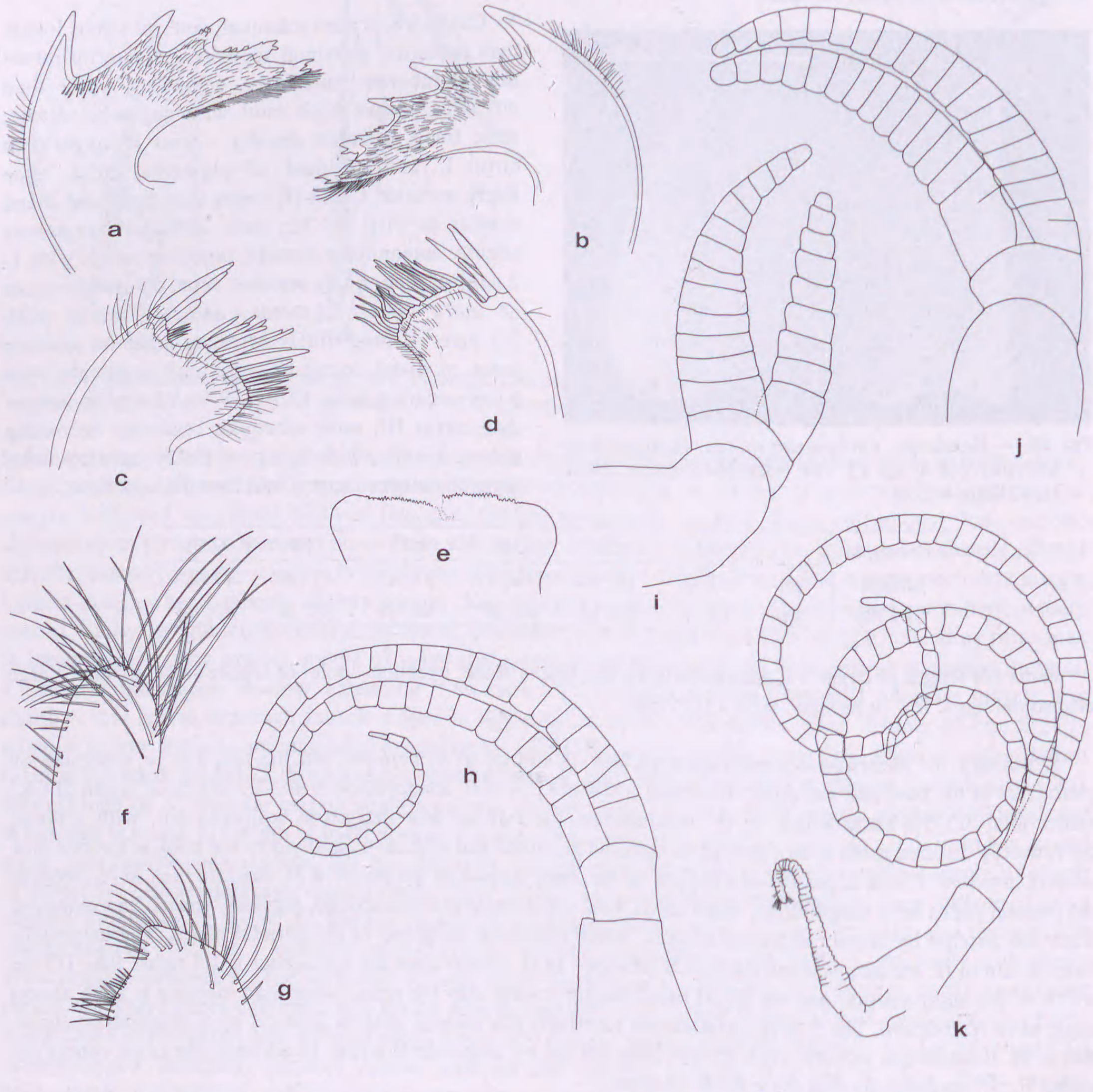

FIG. 70. — *Hexelasma sandaracum* sp. nov. Paratype from MUSORSTOM 4, stn CP 194 (MNHN-Ci 2705): **a**, right mandible; **b**, left mandible; **c**, right maxillule; **d**, left maxillule; **e**, labrum (torn); **f**, mandibular palp; **g**, maxilla; **h**, cirrus III; **i**, cirrus I; **j**, cirrus II; **k**, cirrus VI and penis.

ETYMOLOGY. — From the Greek *sandaraca*, 'orange-colored', in reference to the vivid orange color of the opercular plates and of the large eggs.

DISTRIBUTION. — Vanuatu, 344-1220 m; New Caledonia, 170-960 m; Loyalty Islands, 270-680 m; Norfolk Ridge, 300-540 m; Combe Bank, 700-1300 m; Wallis Islands, 360-765 m; Tuscarora Bank, 547-552 m; Field Bank, 510-600 m.

Hexelasma triderma (Newman & Ross, 1971)

Fig. 64; Tables 28-31

Aaptolasma triderma Newman & Ross, 1971: 164, pl. 33 C-D, 39 F-G. — FOSTER, 1978: 83.
Hexelasma triderma - NEWMAN & ROSS, 1976: 46. — FOSTER, 1981: 356.

MATERIAL EXAMINED. — **Japan**. JYN (Japanyon) III EXP.: stn 51, E of Honshu Island, 34°54.3'N, 139°43.5'E, 549 m, 17.07.1961: holotype (USNM Type 38690).

TYPES. — *Holotype*: USNM 125312; Japan, E of Honshu Island, off Tateyama, JYN III EXPED., stn 51, 34°54.3'N, 139°43.5'E, 549 m, 17.07.1961.
Holotype depository: USNM.

DIAGNOSIS. — Thin parietal plates with thin chitinous layer formed by laterally elongate, thin, longitudinal, chitin-filled tubes, nearly straight in cross-section, separating wall into inner and outer calcareous laminae connected infrequently by small, inconspicuous calcareous bridges; inner and outer laminae equal in thickness. Basal width of CL^2 1/2-2/3 basal width of CL^1. Inferior margin of alae with abrupt, basally directed hook at alar angle, exterior surface strongly marked by growth lines; broad welting along superior alar margin. Basis calcareous; thin centrally, marginally thickened. Opercular and soft parts unknown.

REMARKS. — *Hexelasma triderma* is a large sized species (maximum: RC length 19.5, C height 12.0), which is superficially similar to *H. flavidum* sp. nov., *H. foratum* sp. nov. and *H. sandaracum* sp. nov. Differences between *H. triderma* and these species may be found under *H. flavidum*, *H. foratum* and *H. sandaracum*, respectively.

DISTRIBUTION. — Japan, 549 m.

Hexelasma velutinum Hoek, 1913

Fig. 64; Tables 28-31

Hexelasma velutinum Hoek, 1913: 246 (part). — WITHERS, 1913: 847. — BROCH, 1931: 53 (? part). — HIRO, 1933: 70, pl. 3 fig. 2. — UTINOMI, 1968: 30. — NEWMAN & ROSS, 1971: 155; 1976: 4. — FOSTER, 1978: 79; 1981: 356, figs 6 A-E, 7. — ROSELL, 1991: 37.

MATERIAL EXAMINED. — **Indonesia**. *"Siboga"*: stn 105, 6°08'S, 121°19'E, 275 m, 04.07.1899: 2 specimens syntypes (ZMUA Cirr. 100.322 a), 2 dry specimens (ZMUA Cirr. 100.322).

TYPES. — *Syntypes*: Indonesia,*"Siboga"* stn 105, 6°08'S, 121°19'E, 275 m, 04.07.1899: ZMUA Cirr. 100.322a : 2 specimens, in alcohol; ZMUA Cirr. 100.322: 2 specimens, dry.
Syntypes depository: ZMUA.

DIAGNOSIS. — Parietal plates with lamina of orange chitin applied to inner surfaces. Basal width of CL^2 2/3 basal width of CL^1. External alar surface with parallel growth ridges; narrow, finely crenated welting along superior alar margin. Basis calcareous; thin. Opercular plates white. S convex externally; internal surface distally roughened; crests for lateral depressor muscles absent; externally smooth, widely-spaced, growth lines not cut by longitudinal striae; occludent and articular margins rounded, folded. T spur truncated, more than 1/3 width of basal margin, set slightly apart from basi-scutal angle; inner surface roughened. Mandible with upper margin of tooth 3 and lower margin of tooth 4 with side teeth, lower angle produced into single or bifid spine.

REMARKS. — *Hexelasma velutinum* is a large sized species (maximum: RC length 10.0, C height 13.0). *Hexelasma arafurae* and *H. aureolum* sp. nov. are superficially similar to *H. velutinum*. Differences between these species may be found under *H. arafurae* and *H. aureolum*, respectively.

DISTRIBUTION. — Japan, Philippines to South China Sea; 204-390 m.

DISCUSSION

Wall structure in Chionelasmatoidea and Pachylasmatoidea. — A basal whorl, or whorls, of imbricating plates is present in the chionelasmatoids *Chionelasmus* and *Eochionelasmus*. The wall is 6-plated (R-RL-CL-C), with the RL derived from an imbricating plate which is added to protect the R/CL suture. The upper portion of RL is not incorporated into the sheath and the lower portion is not fully incorporated into the wall.

In the higher balanomorphs, such as the Pachylasmatoidea, CL^2 is added to the wall structure. Within the Pachylasmatidae, four whorls of imbricating plates are present in the eolasmatine *Waikalasma*. The wall is 8-plated (R-RL-CL^1-CL^2-C), with CL^2 added by the replication of CL^1, rather than by transfer from the imbricating whorls. CL^2 only slightly enters the sheath as a very narrow zone. In the pachylasmatine *Pachylasma*, imbricating plates are absent in Recent forms. Imbricating plates are also absent in the new pachylasmatine genera described in the present paper (*Eutomolasma* gen. nov., *Eurylasma* gen. nov. and *Microlasma* gen. nov.). In these pachylasmatines the wall is 6-plated (R-CL^1-CL^2-C), RL and CL^2 are incorporated into the wall but RL is not incorporated into the sheath. In *Eurylasma* CL^2 is partially coalesced with CL^1, but CL^2 enters the sheath as a very narrow zone. The pachylasmatine *Tetrapachylasma*, has a wall that may be 6- or 4-plated, depending on the degree of coalescence of the plates. In the 6-plated form (R-CL^1-CL^2-C), RL coalesces with R to form a compound rostrum (RL+R+RL). In the 4-plated wall (R-CL-C), RL and R form a compound rostrum (RL+R+RL) and CL^2 coalesces with CL^1 to form a compound CL plate. CL^2 enters the sheath as a narrow zone but RL is not incorporated into the sheath, with the exception of *T. ornatum* sp. nov., which shows the incipient inclusion of RL into the sheath.

Imbricating plates are absent in the Metalasmatinae, the Bathylasmatinae and the Hexelasmatinae. In the Metalasmatinae, the Hexelasmatinae and the bathylasmatines *Bathylasma, Mesolasma* and *Tessarelasma,* the wall is 6-plated (R-CL^1-CL^2-C), RL and CL^2 are incorporated into the wall but RL is not incorporated into the sheath. The bathylasmatinae *Tetrachaelasma* has a 4 -plated wall (R-CL-C) due to the absence of CL^2.

Thus the RL does not enter the sheath in the Pachylasmatoidea, with the exception of *T. ornatum* sp. nov. The early balanids (*Palaeobalanus*) and coronulids (*Chelonibia*) reflect the 8-patterned form seen in some pachylasmatoids, including a "tripartite" or compound rostrum (RL-R-RL). In *Chelonibia* DARWIN (1854) noted vestigial sutures on the inner surface as evidence for the coalescence of RL with R. The tripartite rostrum of these higher forms, however, is distinguished from that of pachylasmatoids by the fact that RL enters the sheath. For this situation to occur RL must have been incorporated into the sheath before coalescence with R and, therefore, the two types of tripartite rostra are convergent (BUCKERIDGE & NEWMAN, 1992).

Morphological Characters. — The subtlety of the specific differences within the Pachylasmatoidea can only be determined by examination of a large number of specimens and ontogenetic series. Intra- and inter-specific variation can thus be recognised, definition relying on the combination of consistent differences in a number of characters (e.g. the form of the S and T, the pattern of the wall plates, the length of the caudal appendages). BROCH (1931) first noted the subtle variation found within the Hexelasmatinae in a specimen which he considered to be *H. velutinum*. although he commented that the external features of the S differed from HOEK's description of *H. velutinum*. On re-examining BROCH's material, NEWMAN & ROSS (1971) noted other subtle character differences and re-described the specimen as a new species, *Aaptolasma leptoderma* (Newman & Ross, 1971). These authors also suggested that HOEK (1913) had confounded 2 species in his description of *H. velutinum* and it was

Source : MNHN, Paris

not improbable that the specimens from *"Siboga"* stations 59 and 251 represented *A. leptoderma* rather than *H. velutinum*. A further re-examination of HOEK's material by FOSTER (1981) led him to conclude that in fact 3 species had been confounded in the description - *H. velutinum* from *"Siboga"* station 105, *A. leptoderma* from HOEK's specimen from *"Siboga"* station 59 and *H. arafurae* from *"Siboga"* station 251. However, FOSTER commented that the identification of *H. arafurae* was provisional, as the tergal spur differed from that figured by HOEK for *H. arafurae*, so ".... a definite conclusion about the synonymy must await further material and appreciation about the extent of variation". The studies of NEWMAN and ROSS (1971) and FOSTER (1981) have described a number of new species within *Hexelasma*. The present contribution significantly increases the number of species within *Hexelasma* from 9 to 15 and further extends the known distribution of the genus in the western Pacific Ocean.

Species diversity within *Pachylasma* has also been unrecognised heretofore, primarily due to a paucity of collections and a lack of comparative material. Many of the original species descriptions have been based on an individual or few specimens, with some species having never been re-collected. When a species has been re-collected at a later date, in some instances it has been from an area distant from the type locality and although differences (such as in the form of the S, the T, the pattern of the shell plates, the length of caudal appendages) between the more recently collected specimen(s) and the type specimen have been documented or illustrated, they have received little comment and, presumably, have been attributed to intra-specific variation. However, re-examination of species such *as P. scutistriata* of NILSSON-CANTELL, 1927 (p. 781, fig. 17, pl. 1 fig. 14); *P. scutistriatum* of UTINOMI, 1968 (p. 26, figs 4-5); and *P. aurantiacum* of FOSTER, 1981 (p. 354, figs 2 E, 4) may be warranted.

Significance of antenniformy, reproductive state and regression and/or loss of the penis. — In the Balanomorpha the regression and/or loss of the penis after the reproductive period has been documented in some species (see review of BARNES, 1992). The amount of regression appears to be related to the number of broods produced per year. In species producing 1 brood a year, or with a synchronised first brood of the year, the penis may be completely lost during the long non-breeding period. However, in other species the variable reproductive state of the population may mask this loss. A similar connection between the loss or regression of the penis after reproduction, and which also seems to be related to the number of broods produced in a year, has been found in the Littorinidae. Based on the above evidence, BARNES (1992) argued that the length of the penis of an individual is irrelevant in a species description unless the reproductive state of the individual is also given.

A connection exists between antenniformy, the reproductive state of the cirriped and the regression and/or loss of the penis (ROSS, 1969). ROSS (1969) discussed the functional significance of antenniformy and BARNES (1992) reviewed the reproductive periods and condition of the penis. In cirripeds which have antenniform cirri the penis is usually absent or much reduced. Antenniformy is not found in the Balanidae and is uncommon in the Chthamalidae. In *Chthamalus antennatus* (Pope, 1965) and *Tetrachthamalus oblitteratus* (Newman, 1967) there is clearly a connection between antenniformy and reproduction. Antenniformy is more common in the Tetraclitidae e.g. *Tetraclita* and *Newmanella hentscheli* (Ross & Perreault, 1999); only *Tetraclitella* does not exhibit antenniformy and it is rare in *Tesseropora*, although ROSS (1969) recorded antenniformy, a reduced penis and eggs occurring together in the mantle cavity of *T. pacifica* (Pilsbry, 1928). Antenniform rami occur immediately before, during, and directly after the reproductive period. ROSS (1969) suggested that individuals brooding eggs or nauplii, having antenniform rami, and lacking or having reduced penes, assume the morphology of and act as females. The penis remains non-functional until the beginning of the next reproductive season, whilst the antenniform ramus is replaced by a functional feeding appendage after release of the nauplii.

In the present paper a connection between antenniformy, the reproductive state of the cirriped and the regression of the penis is indicated for the Pachylasmatidae (Table 32). Antenniformy of cirrus II and/or cirrus III was recorded in 11 species - in the pachylasmatines *Eutomolasma maclaughlinae* sp. nov., *E. orbiculatum* sp. nov., *Pachylasma bacum* sp. nov., *P. laeviscutum* sp. nov., *P. ovatum* sp. nov., *Eurylasma pyramidale* sp. nov. and *Tetrapachylasma arcuatum* sp. nov.; in the metalasmatine *Metalasma crassum* sp. nov.; and in the hexelasmatines *Hexelasma foratum* sp. nov., *H. globosum* sp. nov. and *H. sandaracum* sp. nov. Antenniformy was associated

Source : MNHN, Paris

TABLE 32. — Relationship between antenniformy, regression of penes and eggs.

Species	egg size (mm) and colour	antenniformy of CII and/or CIII	penis length	collection date	station no.	depth (m)	registration no.
Eutomolasma maclaughlinae	0.40 x 0.50 orange	+	subequal to CVI	11.05.93	BATHUS 2 DW 719	444-455	WAM C 23247
E. orbiculatum	_	+	1/4 length CVI	06.09.85	BIOCAL DW 83	460	Paratype MNHN Ci 2696
Microlasma fragile	0.40 x 0.42 orange	_	subequal to CVI	16.02.89	MUSORSTOM 6 DW 421	245	Paratype MNHN Ci 2396
Pachylasma bacum	_	+	= length of basal segment of pedicel of CVI	14.02.89	MUSORSTOM 6 CP 401	270	Paratype MNHN Ci 2503
P. laeviscutum	_	+	>1/2 length CVI	12.05.92	MUSORSTOM 7 CP 515	224-252	Paratype MNHN Ci 2697
P. ovatum	_	+	= 1/2 length of basal segment of pedicel of CVI	28.02.85	LAGON DW 444	300-350	Paratype MNHN Ci 2401
Eurylasma angustum	0.37 x 0.43 orange/ yellow	_	1/2 length CVI	28.02.85	MUSORSTOM 6 DW 478	400	Paratype MNHN Ci 2504
E. pyramidale	_	+	almost length of CVI	29.11.89	BATHUS 3 DW 830	361-365	Paratype MNHN Ci 2699
Tetrapachylasma arcuatum	0.40 x 0.42 orange	+	slightly shorter than length of CVI	22.02.89	MUSORSTOM 6 DW 478	400	Paratype MNHN Ci 2700
Metalasma crassum	0.36 x 0.24 yellow	+	= length of basal segment of pedicel of CVI	22.02.89	MUSORSTOM 6 DW 476	300	Paratype MNHN Ci 2409
Hexelasma foratum	0.45 x 0.51 orange	+	1/3 length CVI	20.02.89	MUSORSTOM 6 DW 451	330	Paratype MNHN Ci 2416
Hexelasma globosum	_	+	= length of basal segment of pedicel of CVI	16.09.85	MUSORSTOM 4 CP 167	575	Paratype MNHN Ci 2418
Hexelasma sandaracum	0.35 x 0.25 orange	+	1/4 length CVI	19.09.85	MUSORSTOM 4 CP 194	545	Paratype MNHN Ci 2705

with small numbers of large eggs in 5 species - i.e. *E. maclaughlinae, T. arcuatum, M. crassum, H. foratum* and *H. sandaracum*. Regression of the penis was shown by *M. crassum* (penis equal to the length of the basal segment of the pedicel of cirrus VI). Penile lengths for the remaining 4 species were as follows: subequal to length of cirrus VI (*E. maclaughlinae, M. fragile*), slightly shorter than length of cirrus VI (*T. arcuatum*), 1/3 the length of cirrus VI (*H. foratum*) and 1/4 the length of cirrus VI (*H. sandaracum*). Of the remaining 6 species which showed antenniformy, but which did not have eggs in the mantle cavities, 3 species (*P. bacum, P. ovatum, H. globosum*) showed regression of the penis; penile lengths were 1/2 the length of the basal segment of the pedicel of cirrus VI (*P. ovatum*), and equal to the length of the basal segment of the pedicel of cirrus VI (*P. bacum, H. globosum*). The remaining 3 species (*E. orbiculatum, E. pyramidale, P. laeviscutum*) had larger penes; penile lengths were 1/4 the length of the pedicel of cirrus VI (*E. orbiculatum*), 1/2 the length of cirrus VI (*P. laeviscutum*) and equal to the length of cirrus VI (*E. pyramidale*). One species with large eggs, *Microlasma fragile* sp. nov., showed neither antenniformy nor regression of the penis (length of the penis subequal to cirrus VI). SOUTHWARD & SOUTHWARD (1958) recorded antenniformy of cirrus III in *Bathylasma hirsutum* (as *Hexelasma hirsutum*, then regarded as a chthamalid but now as a bathylasmatine), and NEWMAN & ROSS (1971) recorded antenniformy of the rami of cirri II and III of the bathylasmatine *Tetrachaelasma southwardi*.

Source : MNHN, Paris

Although many cirriped nauplii are pelagic and planktotrophic, some can be lecithotrophic, and develop to the cyprid stage within the mantle cavity of the parent. Animals producing lecithotrophic nauplii usually produce small broods of large size eggs, e.g. deep-water *Scalpellum* and *Arcoscalpellum* species (see BARNES, 1989 for review of egg production in cirripeds). In the present study large eggs, few in number, were recorded in 7 species - the pachylasmatines *Eutomolasma maclaughlinae, Microlasma fragile, Eurylasma angustum, Tetrapachylasma arcuatum,* the metalasmatine *M. crassum* and the hexelasmatines *Hexelasma foratum* and *H. sandaracum*, suggesting that these species are likely to have lecithotrophic larvae. The large size of the eggs of these species is similar to the size of those of hydrothermal vent barnacles (Table 33). Eggs which produce planktotrophic larvae are ovoid, those which produce lecithotrophic larvae are more globular, due to an increased amount of yolk. Lecithotrophy is advantageous for species, such as the deep-water pachylasmatids and scalpellomorphs, and vent barnacles, where restricted dispersal in habitats with few suitable substrata for settlement is advantageous. Abbreviated naupliar development occurs within the mantle cavity and, when released, the cyprid remains in the vicinity of the parent group. No nauplii or cyprids were found in any of the material examined in the present study.

TABLE 33. — Egg characters of hydrothermal vent barnacles.

Species	egg size (mm)	collection date	locality and temp	depth	reference
Neolepas rapanuii	0.3 x 0.5	16.04.89	Easter Island 23°32.52'S, 115°34.0'W	2600 m	Jones, 1993c
Neolepas zevinae	0.3 x 0.5	21.04.89	East Pacific Rise 20°50'S, 109°00'W 1.5-5.0°C	2600 m	Newman, 1979
Neoverruca brachylepadoformis	0.25 x 0.5	-.04.87	Mariana Back-Arc Basin 18°12'S, 144°42'E 5-15°C	3600 m	Newman & Hessler, 1989
Eochionelasmus ohtai ohtai	0.29 x 0.47 (mean)	81.12.87	North Fiji Basin 16°59.4'S, 173°54.9'E +0.1 to +0.2° above ambience of +2.2°C	1990 m	Yamaguchi & Newman, 1997b

Endemism and Species Diversity. — The material examined herein is both rich in numbers of species and numbers of individuals, with an exceptional diversity of species occurring within the subfamilies Pachylasmatinae and Hexelasmatinae. Of the new species described, 1 pachylasmatine (*Tetrapachylasma ornatum* sp. nov.) is endemic to the Marianas Islands, 8 pachylasmatines (*Eutomolasma orbiculatum, Microlasma fragile* sp. nov., *Pachylasma bacum* sp. nov., *P. ovatum* sp. nov., *Eurylasma angustum* sp. nov., *E. ferulum* sp. nov., *E. pyramidale* sp. nov., *Tetrapachylasma arcuatum* sp. nov.), 1 metalasmatine (*Metalasma crassum* sp. nov.) and 5 hexelasmatines (*Hexelasma aureolum* sp. nov., *H. flavidum* sp. nov., *H. foratum* sp. nov., *H. globosum* sp. nov., *H. persicum* sp. nov.) are considered endemic to the region of Vanuatu/New Caledonia. Two pachylasmatines (*Eutomolasma maclaughlinae* sp. nov., *Pachylasma laeviscutum* sp. nov.) and 1 hexelasmatine (*Hexelasma sandaracum* sp. nov.) occur in a broader area, extending from the Indo-Australian Plate to the Futuna and Wallis Islands on the Pacific Plate. The number of new pachylasmatines described in the present study represents 46% of the known species and that of the new hexelasmatines 40%.

The most diverse chionelasmatoid and pachylasmatoid fauna occurs at the Loyalty Islands where 15 species have been collected (1 chionelasmatoid, 1 eolasmatine, 6 pachylasmatines, 1 metalasmatine, 6 hexelasmatines). At the Norfolk Ridge, 11 species have been collected (1 chionelasmatoid, 6 pachylasmatines and 4 hexelasmatines), and nine species are known from both Vanuatu and New Caledonia (1 eolasmatine, 4 pachylasmatines, 1 metalasmatine, 1 bathylasmatine, 2 hexalasmatines and 1 chionelasmatid, 3 pachylasmatines, 5 hexelasmatines respectively). Three species are known from the Chesterfield Islands (2 pachylasmatines, 1 hexelasmatine). On the Pacific Plate, 2 species were collected at Combe Bank (1 pachylasmatine, 1 hexelasmatine). A single pachylasmatine species was collected at both Futuna Island and Waterwich Bank and a single hexelasmatine at the Wallis Islands, at Field Bank and at Tuscarora Bank.

Source : MNHN, Paris

The present study has confirmed that 2 relictual species, the chionelasmatid *Chionelasmus darwini* and the eolasmatine *Waikalasma boucheti* occur in the waters of New Caledonia and of Vanuatu, respectively. However, although *C. darwini* is represented by many specimens, collected at various localities throughout the New Caledonian region, *W. boucheti* is known only by an incomplete specimen from the Loyalty Islands (present report) as well as by 2 specimens from the waters of Vanuatu (BUCKERIDGE, 1996). Similarly, only 1 bathylasmatine - *B. alearum*, represented by 2 specimens from the waters of Vanuatu - has been collected. Sampling by the French deep-sea expeditions has been from comparable depths in the waters of Vanuatu, New Caledonia and the Wallis and Futuna Islands. Whether sampling has been from comparable habitats, however, is a more difficult question to answer, so the possibility exists that species which occur in specialised habitats either have not been collected, or have been collected infrequently.

The cruises BIOCAL and MUSORSTOM 6 gathered a variety of faunas from the Loyalty Islands, of which many are relictual species, e.g. a group of crinoids that were assumed to have died out in the Jurassic - the pedunculate crinoid *Gymnocrinus* and a small black crinoid *Holopus* reported previously from the Caribbean but not from the Pacific Ocean (AMEZIANE-COMINARDI *et al.*, 1987). The presence of the relictual species *Chionelasmus darwini* and *Waikalasma boucheti* at the Loyalty Islands further supports the hypothesis that this bathyal fauna is a vestige of marine populations of the ancient Tethys Sea, and that the south-west Pacific is a relictual area (NEWMAN, 1991).

An abundance and diversity of benthic material has also been collected at the Norfolk Ridge (CHALCAL 2, SMIB 2-5, BATHUS 3, 4). Several groups, such as the calcified sponges of the Sphinctozoa group, the pedunculate crinoid *Gymnocrinus*, molluscs of the family Pleurotomariidae, as well as hydroids and echinoderms, show a clear relationship with the Mesozoic fauna of the ancient Tethys (VACELET, 1977, 1978; BOURSEAU *et al.*, 1987; RICHER DE FORGES, 1990). These living fossils are located on the eastern rim of the ancient continent of Gondwanaland. Abundant zoological collections have also been made from New Caledonia (MUSORSTOM 4, BERYX 2, BATHUS 2), especially sponges, molluscs, stylasters and echinoderms. Many fossilised shark teeth, especially those of the giant species *Procarcharodon megalodon* Agassiz, 1843, have also been collected (RICHER DE FORGES, 1990).

In contrast to the diverse chionelasmatoid and pachylasmatoid fauna occurring in the New Caledonian area, a pachylasmatoid fauna low in diversity and in numbers of individuals and no chionelasmatoids have been found at the Wallis and Futuna Islands on the Pacific plate. The pachylasmatoid species are not new, but are known also from New Caledonian waters. In general, the deep sea faunas from these waters are diverse but quite poor compared to those of New Caledonia, with species described from New Caledonian waters being rediscovered on the Pacific plate (e.g. Sphinctozoa, *Gymnocrinus*, *Amalda*) (RICHER DE FORGES & MENOU, 1993).

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Source : MNHN, Paris

Source : MNHN, Paris

6

Crustacea Decapoda: Review of the genera and species of the family Polychelidae Wood-Mason, 1874

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ABSTRACT

The polychelids are large, uncommon, primitive decapods that inhabit the depths of the world oceans down to 5000 m, between latitudes 50°N and 55°S. A study of major deep-sea collections led to a revision of the family. All genera and species are redescribed and extended synonymies given. Two new genera are established: *Cardus*, for *Polycheles crucifer* (Thomson, 1873) and *Homeryon*, for *Polycheles asper* Rathbun, 1906 and a new species, *H. armarium*. The genus *Pentacheles* Bate, 1878, is revived to include polychelids in which the epipod on third maxilliped is longer than the ischium: *P. gibbus* Alcock, 1894, *P. laevis* Bate, 1878, *P. obscurus* Bate, 1878, *P. synderi* (Rathbun, 1906) and *P. validus* A. Milne Edwards, 1880. *Stereomastis* Bate, 1888 is considered a synonym of *Polycheles* Heller, 1862. *Willemoesia* Grote, 1873 is retained with but four species: *W. forceps* A. Milne Edwards, 1880, *W. inornata* Faxon, 1893, *W. leptodactyla* (Willemoes-Suhm, 1875), and *W. pacifica* Sund, 1920. In all, thirty-two species are recognized, including six new species. The bathymetric and geographic ranges are amended and discussed. A key to the genera and species of the family is provided.

RÉSUMÉ

Crustacea Decapoda : Revue des genres et des espèces de la famille Polychelidae Wood-Mason, 1874.

Les Polychelidae sont des crustacés décapodes primitifs de grande taille et peu communs, qui vivent dans les profondeurs des océans jusqu'à 5000 m et entre les latitudes 50°N et 55°S. Une étude des principales collections faites en eau profonde a conduit à une révision de la famille. Tous les genres et espèces sont redécrits et leurs synonymies complètes sont indiquées. Deux nouveaux genres sont créés: *Cardus* pour *Polycheles crucifer* (Thompson, 1873) et *Homeryon* pour *Polycheles asper* Rathbun, 1906; une espèce nouvelle, *Homerion armarium* sp. nov., est décrite. Le genre *Pentacheles* Bate, 1878, est ressuscité pour accueillir les espèces dont l'épipode des troisièmes maxillipèdes est plus long

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Source : MNHN, Paris

que l'ischion : *P. gibbus* Alcock, 1894, *P. laevis* Bate, 1878, *P. obscurus* Bate, 1878, *P. synderi* (Rathbun, 1906) et *P. validus* A. Milne Edwards, 1880. *Stereomastis* Bate, 1888, est considéré comme étant synonyme de *Polycheles* Heller, 1862. *Willemoesia* Grote, 1873, est conservé mais avec quatre espèces seulement: *W. forceps* A. Milne Edwards, 1880, *W. inornata* Faxon, 1893, *W. leptodactyla* (Willemoes-Suhm, 1875), et *W. pacifica* Sund, 1920. Au total 32 espèces sont reconnues, dont six sont nouvelles. Les répartitions bathymétriques et géographiques sont revues et discutées. Une clé des genres et espèces est proposée.

INTRODUCTION

The depths of the world ocean are home to the eyeless, claw-footed polychelids, "living fossils", kin to the long vanished eryonids, tracing their ancestry back as far as the Mesozoic.

BATE (1888: 100) described his excitement following the finding of polychelids by the "*Challenger*" Expedition: "The great depth from which it was dredged, a depth that was previously believed to be barren, if not of all life, certainly of animals so high in the scale of existence, the apparent absence of the power of vision, and the relationship of the animal to forms of Crustacea that were supposed to have been extinct since the period of the Upper White Jura of Bavaria, gave a considerable degree of interest to the discovery".

Subsequent deep-sea expeditions added new species and extended the range of known ones. However, many species were known from few, damaged, or juvenile specimens, confusing workers searching for valid taxonomic characters. BATE (1888: 141) recognized the problem: "It is highly probable that many of the animals that we determine as specifically distinct, because they are found in widely separated localities, and exhibit some greater or less deviation from each other, would cease to be considered such if they lived side by side, and there can, I think, be little doubt that many of our museum specimens are not really species". A century later, it has remained unsolved: "The taxonomy of the Polychelidae, especially of the generic level, is still very unsettled" (HOLTHUIS, 1991: 88).

The revision comprises adult forms only as "The larval forms of the Polychelidae are incompletely known" (FIRTH & PEQUEGNAT, 1971: 14). A polychelid larva was collected by WILLEMOES-SUHM early on the *"Challenger"* Expedition, and labelled by him "Zoea of Brachyura", but the specimen was recorded by BATE (1882) as a new genus, *Eryoneicus*. Recognized by WOOD-MASON & ALCOCK (1891: 199) as "an immature form of some species of *Pentacheles*", "the question of whether the peculiar forms known as *Eryonicus* are larvae of the crayfish-like deep-sea crustaceans *Polycheles*" (SUND, 1915: 372) was long subject of debate - DE SAINT LAURENT (1979) still argued they are adults secondarily adapted to the bathypelagic existence. Though SUND (1915) tried to match larval forms with adult species using carapacial spine formula, only a few of the nearly 40 larval forms known (GORDON, 1960), are firmly correlated with the adult.

Much of the material examined in this study was collected by the following cruises: MUSORSTOM 1, Philippine Islands, April 1976; MUSORSTOM 2, Philippine Islands, November-December 1980; MUSORSTOM 3, Philippine Islands, May-June 1985; MUSORSTOM 4, New Caledonia, September-October 1985; MUSORSTOM 5, Chesterfiled Islands, October 1986; MUSORSTOM 6, Loyalty Islands, February 1989; MUSORSTOM 7, Wallis and Futuna Islands, May 1992; MUSORSTOM 8, Vanuatu Archipelago, September-October 1994; BIOCAL, New Caledonia and Loyalty Islands, August-September 1985; BIOGEOCAL, New Caledonia and Loyalty Islands, April-May 1987; VOLSMAR, Matthew and Hunter Islands, May-June 1989; KARUBAR, Indonesia, October-November 1991; BERYX 2, Norfolk Ridge, Loyalty Islands, October 1991. BATHUS 1-4, New Caledonia, March 1993-1994; HALIPRO 1, New Caledonia, March 1994; (FOREST, 1981, 1985, 1989; RICHER DE FORGES, 1990, 1993; RICHER DE FORGES & MENOU, 1993; RICHER DE FORGES & CHEVILLON, 1996; RICHER DE FORGES *et al.*, 1996; CROSNIER *et al.*, 1997).

A study of the extensive collections of the Muséum national d'Histoire naturelle, Paris (MNHN), National Natuurhistorische Museum, Leiden (formerly Rijksmuseum van Natuurlijke History) (RMNH), National Museum of Natural History, Smithsonian Institution, Washington (USNM), The Natural History Museum, London (NHM), together with material made available by the Australian Museum, Sydney (AM), American Museum of Natural History, New York (AMNH), Indian Museum, Calcutta (IM), Institut royal des Sciences naturelles de Belgique, Bruxelles (IRScNB), Kitakyushu Museum & Institute of Natural History, Kitakyushu (KMNH), Natural

Source : MNHN, Paris

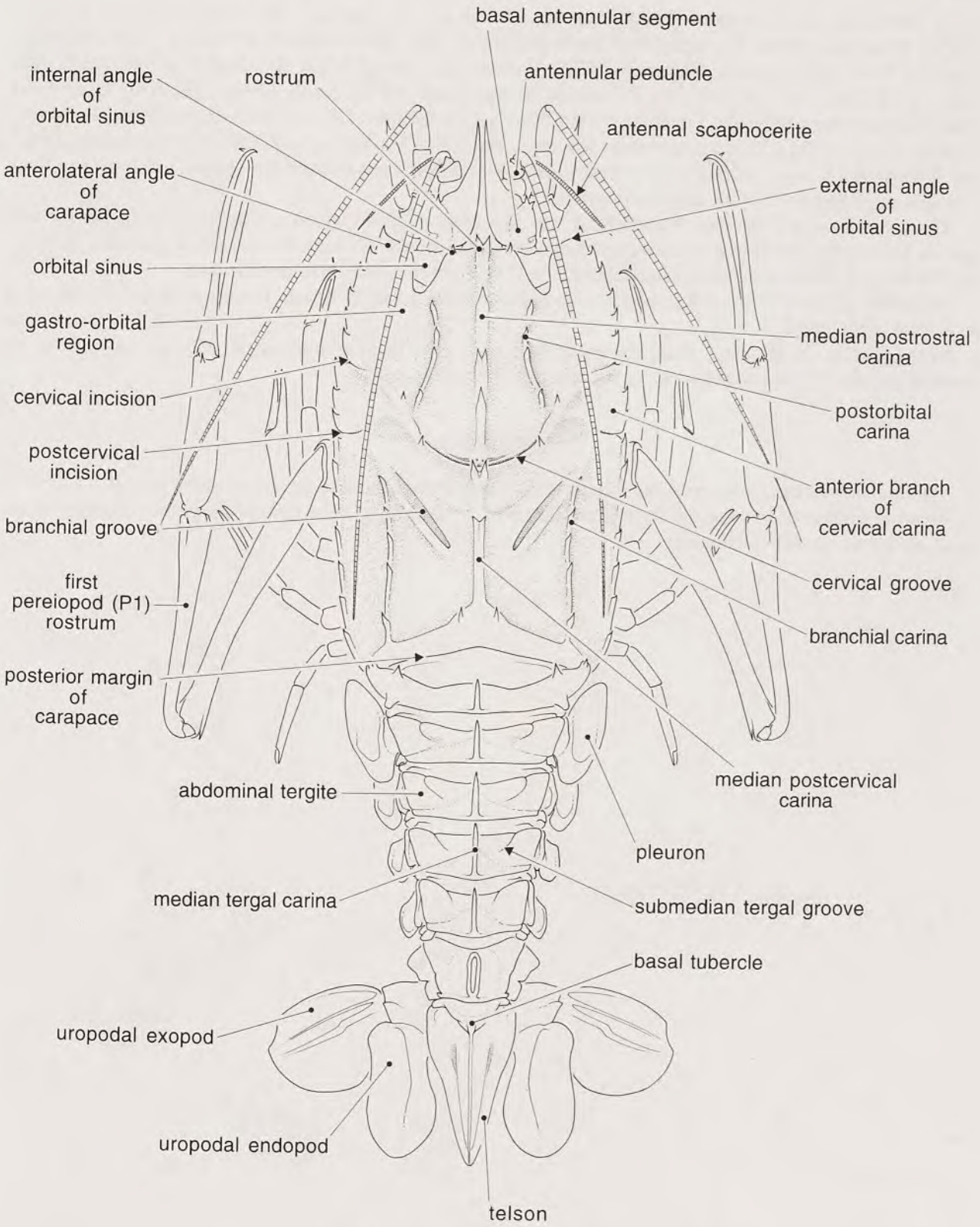

FIG. 1. — Diagrammatic polychelid.

Source : MNHN, Paris

History Museum of Los Angeles (LAM), Museum of Comparative Zoology, Harvard University, Cambridge (MCZ); Museo Zoologico, Universita degli studi di Firenze (MF), Naturhistorisches Museum, Wien (NHMW), Nagasaki University Museum, Nagasaki (NUM), National Institute of Water & Atmospheric Research, New Zealand (NIWA), National Fisheries University, Shimonoseki (NFU), South African Museum, Cape Town (SAM), Senckenberg Museum, Frankfurt (SMF), National Collections, Tel Aviv University (TAU), Tasmanian Museum, Hobart (TM), Western Australian Museum, Perth (WAM), Zoologisk Museum, Copenhagen (ZMC), and Zoological Museum of Moscow University, Moscow (ZMMU) has enabled the reexamination of nearly all type specimens and much of the published material.

The present study divides the Polychelidae into five genera, two of which are new, and describes six new species. Descriptive and distributional information is presented as well as detailed references to literature. All taxa, but *Pentacheles gibbus*, have been photographed, and a key is presented for their identification.

In the lists of Material examined, the names of the cruises are in capital letters. The names of the vessels are in italic letters and quoted.

In the chapter Distribution, when the depth ranges are given without attribution, they are taken from the material examined in the present work, all other records are cited by author.

TERMINOLOGY

The terminology used to describe the species of the family Polychelidae is illustrated on the figures 1-3.

Measurements refer to carapace length from the tip of the rostrum to the middle of the posterior border of the carapace and are given in millimeters.

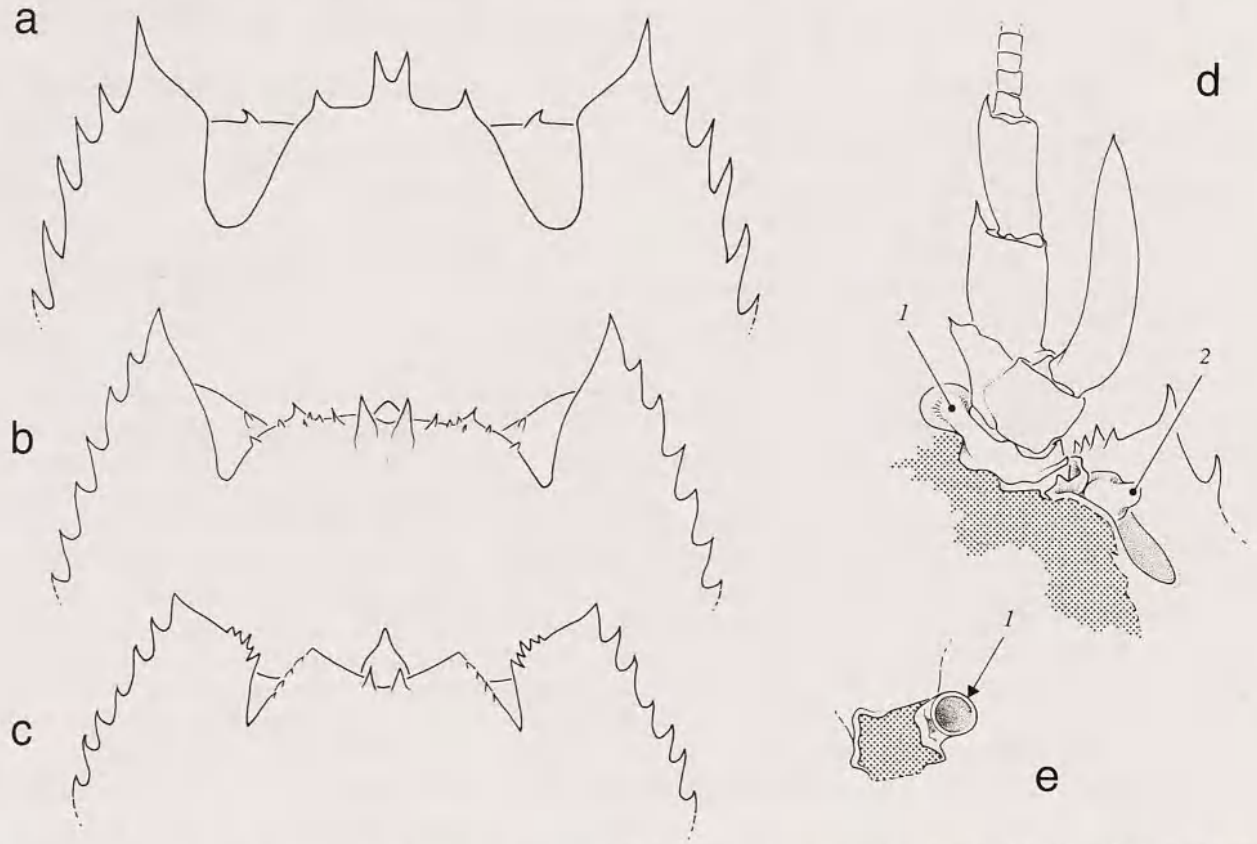

FIG. 2. — **a-c**, frontal margin of carapace: **a**, rostrum bifid; **b**, rostral spines separate; **c**, frontal subterminal tooth prominent, longer than separate rostral spines. — **d**, ventral view showing the renal process of the antenna (1) and the eyestalk (2); **e**, dorsal view showing the aperture of the renal process.

Source : MNHN, Paris

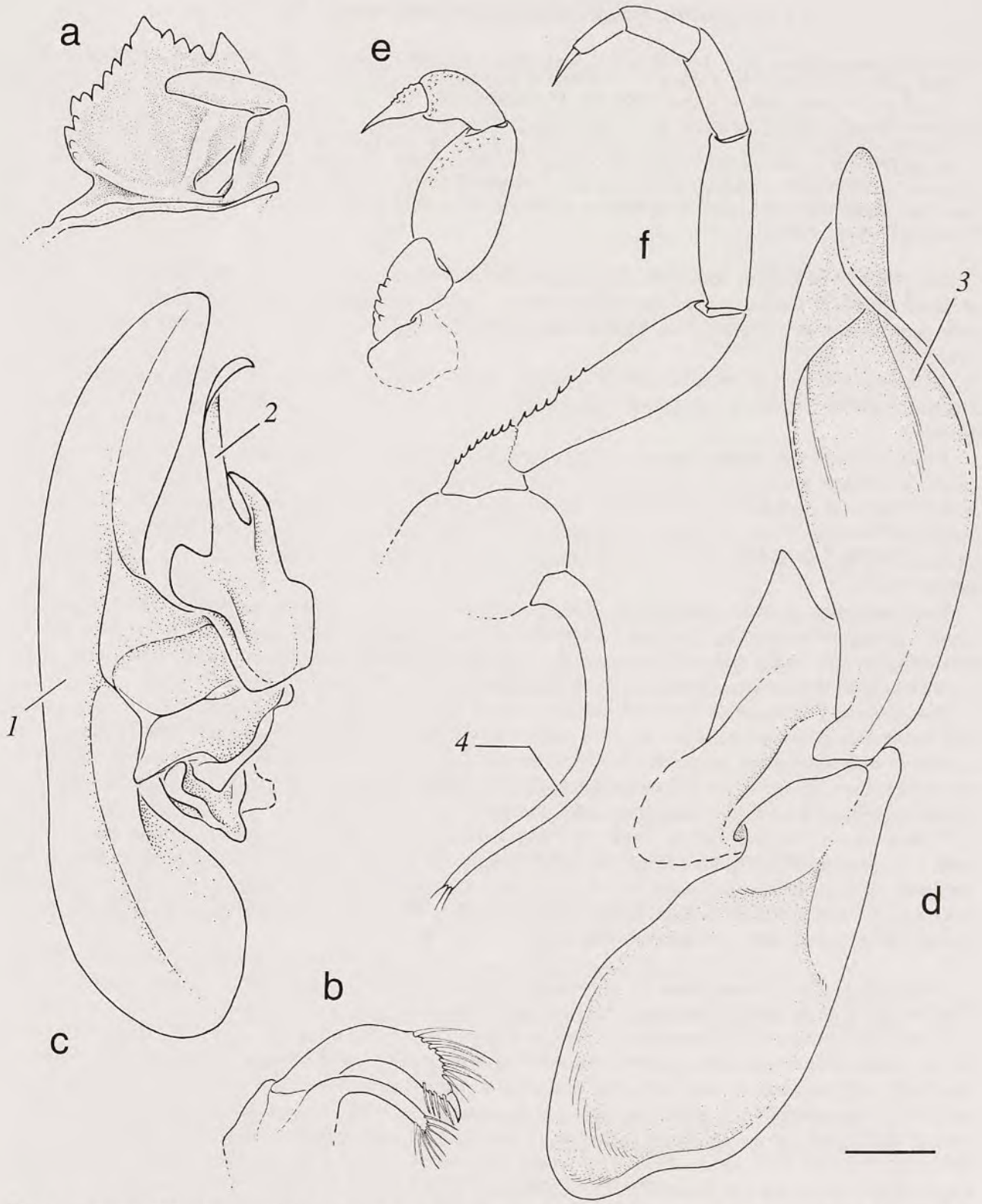

FIG. 3. — **a**, mandible; **b**, maxillula; **c**, maxilla (1, scaphognathite; 2, maxillar lobes); **d**, first maxilliped (3, exopodal lobe); **e**, second maxilliped; **f**, third maxilliped (4, epipod).

Source : MNHN, Paris

Family POLYCHELIDAE Wood-Mason, 1874

Polychelidae Wood-Mason, 1874: 180; 1875: 132. — CARUS, 1885: 485. — BALSS, 1957: 1564. — ZARIQUIEY ALVAREZ, 1968: 208. — GLAESSNER, 1969: 470. — FIRTH & PEQUEGNAT, 1971: 5. — WENNER, 1979: 435. — ABELE & FELGENHAUER, 1982: 306. — RIEDL, 1983: 481. — SQUIRES, 1991: 354.

Eryonidae - BOAS, 1880: 157 (part). — BATE, 1888: 100 (part). — ORTMANN, 1896: 428 (part). — YOUNG, 1900: 439. — ALCOCK, 1901b: 164 (part). — STEBBING, 1902: 35 (part); 1910: 377 (part); 1917: 27 (part). — SELBIE, 1914: 8. — DE MAN, 1916: 1 (part). — BOUVIER, 1917: 26 (part). — PESTA, 1918: 161 (part). — STEPHENSEN, 1923: 65 (part). — BALSS, 1925: 5 (part). — BOONE, 1927: 90 (part). — RODRIGUEZ, 1980: 194 (part).

Eryontidae Smith, 1880a: 345 (part). — STEBBING, 1893: 199 (part). — SCHMITT, 1921: 105 (part).

Polychelida Scholtz & Richter, 1995: 296.

DIAGNOSIS. — Carapace dorso-ventrally flattened, subrectangular or ovate. Anterolateral angle of carapace produced, spiniform. Lateral margins well defined, spinose; cervical and postcervical incisions dividing margin into three parts. One or two rostral spines. Orbital sinus absent, reduced, or well defined. Eyestalk present, lacking cornea.

Cervical groove marked, arcuate, laterally bifurcate. Median postrostral and postcervical carinae well defined, unarmed, granulate, or spinose. Postorbital and branchial carinae obsolescent or well defined, unarmed, granulate or spinose.

Abdomen narrow or broad, laterally or dorsoventrally depressed. First abdominal tergite narrow, pleura fused, abbreviated; latching into posterolateral margins of carapace. Abdominal tergites smooth or sculptured, medially carinate or binodal. Abdominal pleurae diminishing in size posteriorly, smooth or sculptured. Abdominal sternites with or without median knob. Telson lanceolate, bearing two submedian carinae. Uropods lacking transversal suture; uropodal exopod lamellar, endopod bearing denticle or lappet basally on interior margin.

Basal antennular segment flattened, mesial margin granulate or spinose; anterolateral angle with 1-2 spines or without. Outer antennular flagellum short, inner flagellum as long as antennal flagellum. Renal process well developed, tubular, fitting into hollow on underside of basal antennular segment. Antennal scaphocerite short, lingulate or lanceolate; antennal peduncle five-jointed, first segment not fused to epistome.

Buccal opening subquadrate. Mandible concave, cutting edge with triangular teeth of uneven size; mandibular palp biarticulate. Maxillula with two incurved lobes. Maxilla with two slender lobes; large scaphognathite. First maxilliped endopod slender; exopodal lobe membraneous, reniform, extending further back than scaphognathite, exopod anteriorly divided into two lobes enclosing efferent passage. Second and third maxillipeds slender, pediform; epipod on basal segment of third maxilliped rudimentary or long.

Pereiopods 1-4 chelate. P5 either simple or chelate in both sexes, or chelate in female, simple or subchelate in male. First pereiopod larger, more robust than P2-5; pereiopods successively shorter posteriorly. Fingers of first chelipeds crossing, their inner margin furnished with row of overlapping cornute platelets, forming serrate edge. First male pleopod spatuliform, distal margin folded internally. Pleopods 2-6 biramose, with rod-like appendix interna, second pair in male with appendix masculina.

REMARKS. — The Polychelidae is the sole extant family of the superfamily Eryonoidea, a group represented in fossil records from the mid-Triassic period (GLAESSNER, 1969).

H. MILNE EDWARDS (1837) described "Tribu des Eryons", and DE HAAN (1841) erected the family Eryonidae for the fossil genus *Eryon*. HELLER (1863) placed *Polycheles typhlops* in the family Astacidae though he noted its affinity with the fossil *Eryon*. Only after additional material was collected, did WOOD-MASON (1875: 132) write that those specimens " cannot be placed in no existing family of crustaceans, recent or fossil, except perhaps the Eryonidae, the structural characters of which are too incompletely known at present to admit of their being included in it", and established the family Polychelidae. However, most authors continued placing the extant genera within the Eryonidae. The Eryonidae are now considered to be exclusively fossil (BALSS, 1957; GLAESSNER, 1969).

Source : MNHN, Paris

Key to the genera and species of the family POLYCHELIDAE

1. Frontal margin of carapace without orbital sinus ..... *WILLEMOESIA* **4**
— Frontal margin of carapace with orbital sinus **2**

2. Carapace ovate; postorbital and postcervical carinae swollen; fifth pereiopodal dactyl simple in both sexes ..... *CARDUS* gen. nov. (including one species: ***C. crucifer***)
— Carapace ovate or subrectangular; postorbital and postcervical carinae well-defined or obsolescent, never swollen; dactyl of P5 simple or subchelate in male, chelate in female... ..... **3**

3. Epipod of third maxilliped longer than ischium; basal antennular segment proximally quadrate, lamellar ..... *PENTACHELES* **7**
— Epipod of third maxilliped half as long as ischium, basal antennular segment squat .... *HOMERYON* gen. nov. **29**
— Epipod of third maxilliped rudimentary; basal antennular segment proximally rounded .... *POLYCHELES* **11**

4. Sixth abdominal tergite sculptured **5**
— Sixth abdominal tergite nearly smooth **6**

5. Lateral margins of carapace posterior to postcervical incision with less than 10 spines; upper margin of chela with 2 files of spines ..... ***W. inornata***
— Lateral margins of carapace posterior to postcervical incision with more than 20 spines; upper margin of chela with several files of spines ..... ***W. leptodactyla***

6. Lateral margins of carapace anterior to postcervical incision with 15-19 spines; abdominal tergites 2-5 with deep submedian grooves; tip of telson rounded ..... ***W. forceps***
— Lateral margins of carapace anterior to postcervical incision with 6-10 spines; abdominal tergites smooth, lacking deep submedian grooves; tip of telson acuminate .. ***W. pacifica***

7. Internal angle of orbital notch unarmed **8**
— Internal angle of orbital notch spinose **9**

8. Carapace depressed; abdominal terga, pleura nearly smooth ..... ***P. obscurus***
— Carapace convex; abdominal terga, pleura set with conic tubercles ..... ***P. gibbus***

9. Lateral margins of carapace posterior to postcervical incision with 14-15 spines .... ***P. laevis***
— Lateral margins of carapace posterior to postcervical incision with more than 25 spines **10**

10. Carapace subrectangular, densely spinulose; external orbital margin pectinate .... ***P. snyderi***
— Carapace ovate, sparsely spinose; external orbital margin with 0-3 spines .... ***P. validus***

11. One rostral spine **12**
— Two rostral spines **13**

12. Anterior pleuron ovate; inferior surface of uropodal exopod bicarinate ..... ***P. typhlops***
— Anterior pleuron rounded; inferior surface of uropodal exopod tricarinate . ***P. perarmatus***

13. Antero-external margin of basal antennular segment unispinose **14**
— Antero-external margin of basal antennular segment bispinose **15**

Source : MNHN, Paris

14. Carina of fifth abdominal segment with antrorse spine; carapace between branchial and median postcervical carinae spinose ..... ***P. phosphorus***
— Carina of fifth abdominal segment unarmed; carapace between branchial and median postcervical carinae unarmed ..... ***P. politus*** sp. nov.

15. Frontal submarginal tooth prominent, longer than separate rostral spines **16**
— Frontal submarginal tooth shorter than rostrum, or rostrum bifid **17**

16. Gastro-orbital region bispinose; median postrostral and postcervical carinae irregularly granulate; second pleuron ovate; upper margin of first chela prominently spinulose ..... ***P. baccatus***
— Gastro-orbital region quadrispinose; median postrostral and postcervical carinae set with antrorse tubercles; second pleuron anteriorly triangulate; upper margin of first chela granulose ..... ***P. coccifer*** sp. nov.

17. Internal angle of orbital sinus unarmed **18**
— Internal angle of orbital sinus spinose **19**

18. Antrorse spine on fifth abdominal tergite large, overhanging anterior margin of fourth tergite ..... ***P. ceratus***
— Antrorse spine on fifth abdominal tergite not as above ..... ***P. helleri***

19. Median carina on abdominal tergites 2-5 bicuspid, anteriorly spinose; gastro-orbital region quadrispinose anteriorly, cluster of 5-6 spines posteriorly ..... ***P. suhmi***
— Median carina on abdominal tergites 2-5 not cuspidate; spinulation of gastro-orbital region otherwise **20**

20. Frontal margin with several spinules on either side of rostral spines ..... ***P. enthrix***
— Frontal margin with single spine on internal angle of orbital sinus **21**

21. Cheliped carpus one third as long as merus ..... ***P. tanneri***
— Cheliped carpus half as long as merus **22**

22. Branchial groove with a distal spine **23**
— Branchial groove unarmed **25**

23. Carapace between branchial and median postcervical carinae unarmed posteriorly; median carina on fifth abdominal tergite anteriorly bulbous ..... ***P. pacificus***
— Carapace between branchial and median postcervical carinae posteriorly spinose; median carina on third abdominal tergite bearing long antrorse spine; fourth and fifth abdominal tergites unarmed ..... ***P. trispinosus***
— Carapace between branchial and median postcervical carinae posteriorly spinose; median carina on fifth abdominal tergite bearing antrorse spine **24**

24. Antrorse spine on third abdominal tergite largest; lyre-shaped carina on sixth abdominal tergite prominently denticulate; basal tubercle on telson salient ..... ***P. nanus***
— Antrorse spine on fifth abdominal tergite largest; lyre-shaped carina on sixth abdominal tergite rounded; basal tubercle on telson blunt ..... ***P. evexus*** sp. nov.

25. Median carina of fifth abdominal tergite with antrorse spine **26**
— Median carina of fifth abdominal tergite without antrorse spine **27**

26. Sixth abdominal tergite bearing lyre-shaped, denticulate carina mesially; lateral margins of carapace posterior to postcervical incision with 8-10 spines ..... ***P. talismani***
— Sixth abdominal tergite bearing parallel rounded carinae, confluent anteriorly and posteriorly; lateral margins of carapace posterior to postcervical incision with 6-7 spines .. .. ***P. sculptus***

Source : MNHN, Paris

27. Posterior margin of cervical groove with single antrorse spine midway between median postcervical and branchial carinae; frontal submarginal tooth prominent, visible in dorsal view; second pleuron anteriorly triangulate ..... ***P. aculeatus*** sp. nov.
— Posterior margin of cervical groove with 3 or 4 antrorse spines midway between median postcervical and branchial carinae; frontal submarginal tooth small; second pleuron ovate.. ..... **28**

28. Lateral margins of carapace posterior to postcervical incision with 7 spines; submedian grooves on abdominal tergites marked; lyre-shaped carina on sixth tergite prominent .... ***P. auriculatus***
— Lateral margins of carapace posterior to postcervical incision with 10-14 spines; submedian grooves on abdominal terga obsolescent; lyre-shaped carina on sixth tergite obsolescent ..... ***P. surdus*** sp. nov.

29. Lateral margins of carapace posterior to postcervical incision cristate, serrulate; abdominal carina blunt; second pleuron cordiform; uropods smooth ..... ***H. asper***
— Lateral margins of carapace posterior to postcervical incision rounded, bearing rows of antrorse spinules; abdominal carina bicuspid; second pleuron reniform; uropods granulate . ..... ***H. armarium*** sp. nov.

Genus ***CARDUS*** nov.

TYPE SPECIES. — *Deidamia crucifer* Thomson, 1873. Gender masculine.

DIAGNOSIS. — Carapace dorsoventrally flattened, ovate. Anterolateral angle of carapace produced, spiniform. Lateral margins well defined, spinose; cervical and postcervical incisions markedly dividing margin into three parts. Single rostral spine. Orbital sinus reduced, vermicular process of eyestalk filling orbit.

Cervical groove marked, arcuate, laterally bifurcate. Median postrostral and postcervical carinae well defined, swollen, granulate. Postorbital and branchial carinae swollen, well defined, granulate.

Abdomen narrow, laterally depressed. First abdominal tergite narrow, pleuron abbreviated. Abdominal tergites 2-5 sculptured, medially binodal; sixth tergite medially bituberculate. Abdominal pleura bearing granulate basal protuberance; second and third pleura lingulate, fourth pleuron triangulate, fifth acuminate. Abdominal sternites with median knob. Telson lanceolate, with a basal median tubercle and two submedian carinae. Uropodal exopod lamellar, oar-shaped; endopod lanceolate with a basal denticle on interior margin.

Mesial margin of basal antennular segment spinose, upcurved, anteriorly produced, not reaching base of peduncle; anterolateral angle spinose. Antero-internal angle of second, third antennular segments prominently spiniform. Outer antennulary flagellum short, inner flagellum as long as antennal flagellum. Renal process well developed, tubular, fitting into hollow on underside of basal antennular segment. Antennal scaphocerite short, lanceolate, extending beyond second peduncular segment.

Buccal opening subquadrate. Mandible concave, cutting edge with triangular teeth of uneven size; mandibular palp biarticulate. Maxillula with two incurved lobes, spiniform setae distally on anterior lobe. Maxilla with two slender lobes, internal lobe half as long as lateral; large scaphognathite. First maxilliped endopod slender, exopodal lobe membraneous, reniform, extending further back than scaphognathite; exopod anteriorly divided into two lobes enclosing efferent passage. Second and third maxillipeds, slender, pediform; basal segment of third maxilliped bearing long epipod; dactyl as long as both preceding segments.

Pereiopods 1-4 chelate, P5 simple in both sexes. P1 larger, more robust than P2-5; pereiopods successively shorter posteriorly. Fingers of first, second chelipeds crossing, their inner margin furnished with row of overlapping cornute platlets, forming serrate edge. Fingers of third, fourth pereiopodal chelae slightly upcurved, their inner margins simple. First male pleopod spatuliform, spinulose swelling distally on inner margin, spinules

Source : MNHN, Paris

distally on mesial margin, distal margin folded internally. Pleopods 2-6 biramose, with rod-like appendix interna, second pair in male with appendix masculina.

ETYMOLOGY. — From the Latin, *carduus* (= thistle), referring to the spinose, thistle-like carapace.

REMARKS. — *Cardus* is distinguished from the other polychelid genera in having the fifth pereiopodal dactyl simple in both sexes. It is further distinguished from *Polycheles* by the antero-internal process of the basal antennular segment not reaching the base of the peduncle; the basal segment of the third maxilliped bearing a long epipod; the fingers of the second and third pereiopods slightly upcurved, and their internal margin simple.

WILLEMOES-SUHM (1875c: xxxiii) correctly distinguished *crucifer*: "hat nur Scheeren an vieren und wird vielleicht mit dei Zeit ein eigenes Genus bilden mussen".

Cardus crucifer (Thomson, 1873)

Fig. 4

Deidamia crucifer Thomson 1873: 247, fig. 1. — WOOD-MASON, 1874: 180.
Willemoesia crucifer - GROTE, 1873: 485. — HUMBERT, 1874: 130. — WILLEMOES-SUHM, 1875b: 577; 1875c: xxxiii. — THOMSON, 1877: 256, fig. 59. — GIGLIOLI, 1912: 160.
Willemoesia crucifera - WILLEMOES-SUHM, 1875a: 52, pl. 12 fig. 10, pl. 33 figs 10-11. — NORMAN, 1879: 174. — PAGENSTECHER, 1879: 37.
Polycheles crucifer - WOOD-MASON, 1875: 132. — BATE, 1878a: 277, pl. 13 figs 6-8; 1878b: 484; 1878c: 563. — BOAS, 1882: 352, fig. 12. — MARSHALL, 1888: 267. — FAXON, 1896: 155. — BOUVIER, 1905a: 480; 1905b: 644; 1905c: 3; 1905d: 2; 1917: 36; 1925: 428, figs 5-8, pl. 4 fig. 4, pl. 11 figs 7-14. — DE MAN, 1916: 5 (list). — SCHMITT, 1935: 171, fig. 35. — BERNARD, 1953: 86. — CHACE, 1960: 30, fig. 9b. — FIRTH & PEQUEGNAT, 1971: 42. — PEQUEGNAT *et al.*, 1971: 4. — BEAUBRUN, 1979: 33, fig. 19. — GONZALEZ, 1995: 124. — DAWSON, 1997: 8.
Pentacheles crucifer - FILHOL, 1884: 231.
Polycheles crucifera - BATE, 1888: 127, fig. 31, pl. 13. — YOUNG, 1900: 440. — RICHARD, 1905: 3. — TÜRKAY, 1976: 27, fig. 5.
Polychelles crucifer - RODRIGUEZ, 1980: 194 [erroneous spelling].

MATERIAL EXAMINED. — **Ibero-Morrocan Gulf**. BALGIM: stn CP 10, 36°45'N, 9°32'W, 1582-1602 m, 29.05.1984: 1 ♂ 15.4 mm (MNHN-Pa 1675). — Stn CP 69, 35°11'N, 7°50'W, 1978-2077 m, 5.06.1984: 2 juvs (MNHN-Pa 1676). — Stn CP 99, 34°28'N, 7°43'W, 1848-1892 m, 9.06.1984: 3 juvs (MNHN-Pa 1677).

Canary Is. CANCAP 2: stn 2.131, 27°40'N, 18°10'W, 1200-1800 m, 8.09.1977: 3 juvs (RMNH).

CANCAP 4: stn 4.056, 28°47'N, 13°22'W, 1306-1345 m, 18.05.1980: 1 ♂ 17.0 mm (RMNH). — Stn 4.057, 28°27'N, 13°24'W, 1300-1335 m, 19.05.1980: 1 ov. ♀ 22.9 mm (RMNH).

United States (East coast). *"Gerda"* (id. L.B. HOLTHUIS): stn 223, Florida Str., 24°18'N, 80°29'W, 897-915 m, 23.01.1964: 1 juv. (USNM 136603). — Stn 296, Florida Str., 25°36'N, 79°23'W, 715 m, 5.04.1964: 1 ♀ 21.3 mm (USNM 136604). — Stn 266, Florida Str., 24°12'N, 81°17'W, 679-709 m, 15.09.1964: 1 ♀ 22.6 mm (RMNH 22396). — Stn 374, Florida Str., 23°50'N, 81°37'W, 1208-1241 m, 17.09.1964: 2 ♀ 20.5, 21.4 mm; 1 juv. (USNM 136605).

Bahama Is. *"Albatross"*: stn 2629, 23°48'07"N, 75°10'07"W, 2104 m, 8.03.1886, id. M.J. RATHBUN: 2 juvs (USNM 11422). — Stn 2654, 27°57'05"N, 77°27'05"W, 1188 m, 2.05.1888, id. M.J. RATHBUN: 2 juvs (USNM 11460).

"Iselin": stn 40, 23°46'N, 76°58'W, 1317 m, 22.02.1972, id. F.M. BAYER: 1 ♂ 17.6 mm; 1 juv. (USNM 154313). — Stn 51, 23°37'N, 76°49'W, 1290 m, 25.02.1972: 1 ♀ 18.8 mm; 2 juvs (RMNH). — Stn 156, 23°43'N, 76°50'N, 1334 m, 5.02.1974: 1 ♂ 14.8 mm; 2 ♀ 18.3, 25.6 mm (RMNH). — Stn 163, 23°32.5'N, 77°09.9'W, 1342 m, 6.02.1974: 1 ♀ 16.1 mm (RMNH). — Stn 301, 23°51.95'N, 76°52'W, 1304 m, 3.04.1975: 1 ♂ 16.9 mm; 2 ♀ 21.5, 25.7 mm; 1 juv. (RMNH). — Stn 302, 24°11'N, 77°23.2'W, 1452 m, 3.04.1975: 1 juv. (RMNH). — Stn 316, 24°24'N, 76°26.75'W, 1567 m, 7.04.1975: 2 ♀ 15.8, 19.5 mm (RMNH). — Stn 321, 23°39.25'N, 76°46.24'W, 1328 m, 8.04.1975, id. F.M. BAYER: 2 ♀ 19.3, 26.6 mm; 1 juv. (USNM 154320). — Stn 322, 23°40.5'N, 77°03.5'W, 1362 m, 8.04.1975: 1 ♀ 19.3 mm (RMNH).

"Pillsbury": stn 634, 23°33'N, 82°47'W, 1638-1757 m, 25.03.1968: 5 ♀ 13.3-24.8 mm (RMNH).

West Indies. *"Challenger"*: stn 23, Leeward Is, Sombrero I., 18°24'N, 63°28'W, 810 m, 15.03.1873: 1 ♂ 19.0 mm (NHM 1888.22).

Caribbean Sea. *"Albatross"*: stn 2117, Aves Ridge, 15°24'40"N, 63°31'30"W, 1229 m, 27.01.1884: 1 ♂ 15.0 mm; 1 ♀ 20.3 mm, 2 juvs (USNM).

"Oregon": stn 1907, 12°25'N, 82°23'W, 720-765 m, 11.09.1957: 1 ♀ 27.5 mm (USNM 251942). — Stn 3561, 16°35'N, 80°04'W, 720 m, 18.05.1962: 1 ♂ 16.6 mm; 2 ♀ 21.8, 24.5 mm (USNM 244083). — Stn 4566, 23°05'N,

Source : MNHN, Paris

86°09'W, 1260 m, 6.12.1963: 1 ♀ 22.1 mm; 2 juvs (USNM 273140). — Stn 5753, 29°29'N, 79°53'W, 675 m, 19.11.1965: 1 ♀ 26.9 mm (USNM 273140). — Stn 5930, 15°38'N, 61°07'W, 796 m, 5.03.1966: 1 ♀ 22.7 mm (USNM 273140). — Stn 6697, 17°47'N, 63°09'W, 792-828 m, 18.05.1967: 2 ♀ 27.0 28.0 mm (USNM 273140). — Stn 6703, 16°53'N, 61°53'W, 738-828 m, 21.05.1967: 1 ♀ 29.6 mm (USNM 273140). — Stn 6705, 17°14'N, 63°01'W, 693-765 m, 22.05.1967: 2 ov. ♀ 28.5, 29.7 mm (USNM 273140).

"Oregon II": stn 10825, Martinique, 15°42'N, 61°08'W, 630 m, 1.12.1969: 1 ♀ 25.7 mm (USNM 283646). — Stn 10831, Saba I., 17°38'N, 63°48'W, 641 m, 3.12.1969: 1 ♀ 24.6 mm (USNM 283650). — Stn 10835, St. Martin I., 18°28'N, 63°23'W, 671 m, 6.12.1969: 1 ♀ 27.4 mm (USNM 283649).

"Gilliss": stn 31, 16°58'N, 79°28.1'N, 1116-1088 m, 28.07.1972: 1 ♂ 17.5 mm; 3 ♀ 19.8-21.2 mm; 6 juvs (RMNH).

Gulf of Mexico. *"Oregon"*: stn 3516, 29°33'N, 88°38'W, 720 m, 18.03.1962: 3 ♂ 18.1-18.4 mm; 5 ♀ 16.1-26.9 mm; 4 juvs (USNM). — Stn 4570, 23°11'N, 86°28'W, 900 m, 7.12.1963: 1 ♀ 20.8 mm (USNM 260368). — Stn 4815, 25°05'N, 96°27'W, 720 m, 12.04.1964: 1 ♀ 21.7 mm (USNM 260368).

TYPES. — The male (19.0 mm cl) (NHM 1882.22) collected by the *"Challenger"* stn 23 off Sombrero I. (18°24'N, 63°28'W, 810 m), is the holotype.

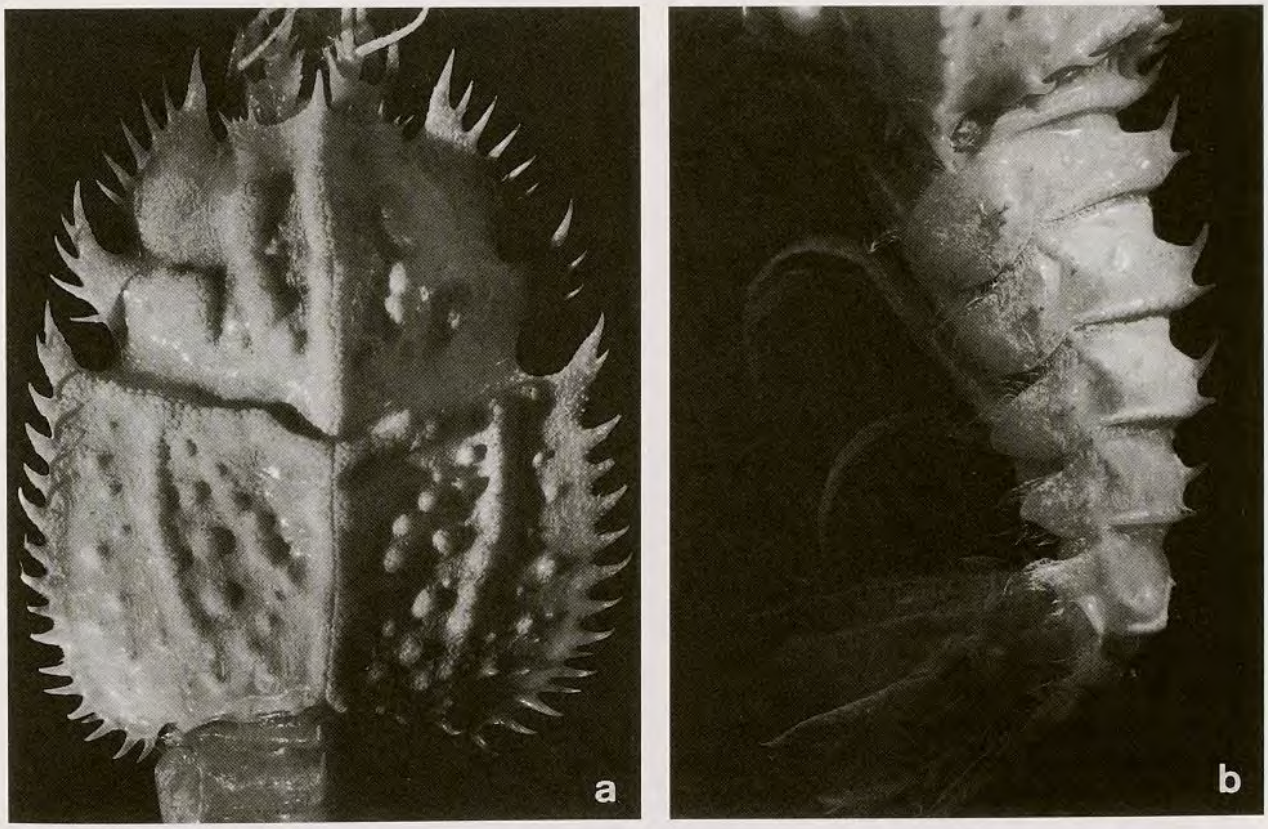

FIG. 4. — *Cardus crucifer* (Thomson, 1873), ♀ 27.0 mm, Caribbean Sea, *"Oregon"* stn 6697, 17°47'N, 6°39'W, 792-828 m (USNM 273140): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

DESCRIPTION. — Carapace ovate, granular, setose. Dorsal surface of carapace bearing swollen carinae. Two pairs of granulate submedian carinae anterior to cervical groove, lateral pair short; granulated tubercles posterior to cervical groove, some along branchial carina, some scattered. Posterior margin of cervical groove raised. Anterior margin of carapace nearly straight; single rostral spine prominent, upcurved. Internal angle of orbital sinus prominently bispinose, external angle unarmed. Eyestalk curved distad under anterolateral angle of carapace; vermicular appendage projects dorsally into orbital sinus, with basal spine directed forward. Basal antennular segment squat, produced anteriorly to a sharp point; mesial margin spinose, two distalmost spines largest; single spine on antero-external angle. Lateral margins of carapace armed with long, slender, upcurved spines; spine

Source : MNHN, Paris

formula 6,7:5:17; anterior spine in each section most prominent. Posterior margin of carapace with three pairs of antrorse spines, lateral pair largest.

Abdominal tergites granulate, medially carinate. Anterior tergite bearing antrorse spine. Tergites 2-5 with bispinose median carina, anterior spine antrorse, submedian shallow oblique grooves. Carina on sixth tergum blunt. Pleura bearing granulate tubercle mesially, scattered granules posterioly. Telson distally with two obtuse submedian carinae.

Merus of P1 with margins smooth, lacking subterminal spine. Carpus triangular, very short, small subterminal spines on upper and lower margins. Chela swollen, upper margin irregularly spinose, distalmost spine largest.

Color. — Described by WILLEMOES-SUHM (1875a: 53) as "very beautiful", "a fine red, while the hairs bordering it were yellowish".

BOUVIER's (1925: 432) description relies on a watercolor sketch taken aboard the "*Talisman*": "un ton jaunâtre clair un peu lavé de rose; cette dernière devient plus forte en dehors de la ligne médiane sur la région gastrique; elle est également assez nette sur la ligne médiane de l'abdomen. Les pattes antérieures sont d'un gris noirâtre clair également un peu lavé de rose".

DISTRIBUTION. — Eastern Atlantic: Portugal, Morocco, Canary Is, Azores; Western Atlantic: Florida Str., Bahama Is, Gulf of Mexico, West Indies, Caribbean Sea; 549-2195 m.

Genus ***HOMERYON*** nov.

TYPE SPECIES. — *Homeryon armarium* sp. nov. Gender masculine.

DIAGNOSIS. — Carapace dorsoventrally flattened, ovate. Anterolateral angle of carapace produced, spiniform. Lateral margin divided into three parts by cervical and postcervical incisions. Two rostral spines. Orbital sinus slit-like. Eyestalk filling orbit, vermicular tip distad, beneath anterolateral angle of carapace.

Cervical groove marked, arcuate, laterally bifurcate. Postrostral and postcervical median carinae well defined, granulate, spinulate. Branchial carina well defined.

Abdomen broad, depressed. First abdominal tergite narrow, pleuron abbreviated. Abdominal tergites 2-5 sculptured, medially carinate; sixth tergite medially tuberculate. Abdominal pleura 2-5 rounded, successively diminishing in size posteriorly; sixth pleuron subquadrate. Abdominal sternites with median knob. Telson lanceolate, with short median basal ridge, two submedian carinae. Uropodal exopod lamellar, rounded; endopod oar-shaped, with basal lappet on interior margin.

Mesial margin of basal antennular segment anteriorly produced, upcurved, spinose, shorter than peduncle; segment proximally squat, anterolateral angle spinose. Outer antennular flagellum short, inner flagellum as long as antennal flagellum. Renal process well developed, tubular, fitting into hollow on underside of basal antennular segment. Antennal scaphocerite lingulate, reaching to base of flagellum.

Buccal opening subquadrate, lateral margins prominent, keel-like. Mandible concave, cutting edge with triangular teeth of uneven size; mandibular palp biarticulate. Maxillula with two incurved lobes, distally setose. Maxilla with two slender lobes, internal lobe half as long as lateral; large scaphognathite. First maxilliped endopod slender, exopodal lobe membraneous, reniform, extending further back than scaphognathite, exopod anteriorly divided into two lobes enclosing efferent passage. Second and third maxillipeds slender, pediform; epipod on basal segment of third maxilliped half as long as ischium; dactyl slightly longer than preceding segment.

Pereiopods 1-4 chelate; P5 chelate in female, subchelate in male. P1 robust; pereiopods successively shorter posteriorly. Fingers of P1-2 crossing, their inner margin furnished with row of overlapping cornute platelets, forming serrate edge. Fingers of chelae of P3-5 markedly upcurved.

ETYMOLOGY. — Named for Homer, the blind poet, and *eryon* - the first name ever used for the fossil kin of the polychelids.

REMARKS. — *Homeryon* gen. nov. differs from the other polychelid genera in having epipod on basal segment of third maxilliped half as long as ischium; basal antennular segment squat; lateral margins of buccal opening prominent, keel-like; fingers of pereiopodal chelae 3-5 upcurved.

Homeryon armarium sp. nov.

Fig. 5

Polycheles sp. - BABA, 1986: 157, 283, pl. 108.

MATERIAL EXAMINED. — **Kyushu-Palau Ridge**, 700 m, 18.12.1979, coll. M. TORIYAMA: 1 ♀ 58.1 mm (NFU 530-2-0740); 1 ♀ 56.0 mm (NFU 530-2-1489). — 28°04'N, 134°20'E, 520 m, 20.02.1978, coll. O. TABATA: 2 ♀ 61.4, 61.1 mm (NFU 530-2-0975).

Japan (?). Coll. T. SAKAI: 1 ♂ 37.7 mm (SMF 24649).

TYPES. — The female (58.1 mm cl) (NFU 530-2-0740) collected on the Kyushu-Palau Ridge, is the holotype; the other specimens (NFU 530-2-0975, NFU 530-2-1-489) are paratypes.

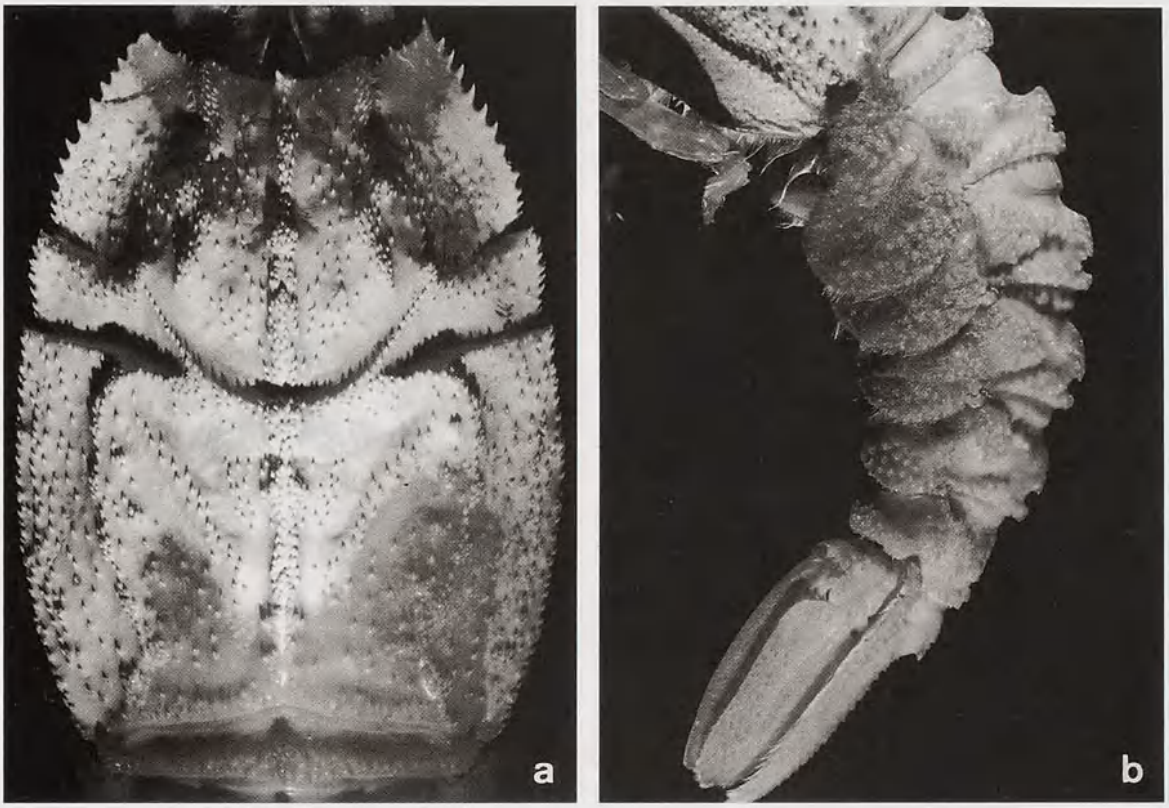

FIG. 5. — *Homeryon armarium* sp. nov., ♀ 58.1 mm, holotype, Kyushu-Palau Ridge, 700 m (NFU 530-2-0740): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

DESCRIPTION. — Dorsal surface of carapace setose, covered with robust, antrorse spinules. Frontal margin concave. Internal angle of orbital sinus triangulate, dense with antrorse spinules. Outer orbital margin pectinate. Eyestalk bearing vermicular process, pointing distad. Antennular segment bearing spinose tubercle on antero-external angle. Lateral margins of carapace anterior to postcervical incision cristate, bearing 11-14 spines. Posterolateral angle of cervical incision set with robust, antrorse spinules. Lateral margins of carapace posterior to postcervical incision rounded, with several irregular rows of robust, antrorse spinules. Median postrostral and postcervical cari-

nae swollen, thickly set with antrorse spinules; spinules blunter, more numerous behind cervical groove. Postorbital carina swollen, thickly set with antrorse spinules. Cervical carina set with row of spinules, terminating in spinose tubercle. Posterior margin of cervical groove minutely spinulose. Branchial carina sinuous, set with clumps of antrorse spinules. Posterior margin of branchial groove spinose. Posterior margin of carapace smooth.

Abdominal tergites 1-5 sculptured, prominently tuberculate, mesially carinate. Tergites 2-5 with deep transversely oblique grooves laterally. Carinae 2-5 bicuspid, anterior cusp larger, prominently granulose. Sixth tergite bearing obsolescent granules mesially and laterally. Second pleuron reniform, granulate, with short groove mesially; pleura 3-4 posteriorly granulate, with short rib mesially. Basal tubercle on telson granulate, submedian carinae prominently tuberculate, lateral margins thickly set with acuminate tubercles. Uropodal exopod and endopod thickly set with spinules laterally.

Merus of P1 serrulate on lower margin and with a subterminal spine on upper margin; carpus of P1 3/4 as long as merus, spinose on upper margin; chela of P1 spinose on upper and lower margins. Merus of P2 with several rows of spines on lower margin and subterminal spines on upper margin; carpus and chela of P2 spinose on upper margin.

Color. — Uniformly orange-red. Color plate in BABA (1986, fig. 108).

ETYMOLOGY. — From Latin, *armarium* (= chest, box) refers to the stocky, robust carapace of the species.

REMARKS. — "These specimens are not referred to any of the species in the literature now available to me. The granulate body, short basal segment of antennule and dactyli of 3rd and 4th pereopods curving outward seems to be unique to this species" (BABA, 1986: 283). Indeed, the slit-like orbital sinus, squat basal antennular segment and the curved dactyli of 3-4 pereiopods are among the features that distinguish *Homeryon* gen. nov. from the other polychelid genera.

DISTRIBUTION. — Kyushu-Palau Ridge, Japan; 520-700 m.

Homeryon asper (Rathbun, 1906)

Fig. 6

Polycheles asper Rathbun, 1906: 899; pl. 24 fig. 11. — DE MAN, 1916: 5 (list). — BOUVIER, 1917: 35. — FIRTH & PEQUEGNAT, 1971: 41. — DAWSON, 1997: 7.

MATERIAL EXAMINED. — **Hawaiian Is**. *"Albatross"*, stn 4174, Niihau I., 1323-1557 m, 1902: 1 ♀ 32.0 mm (USNM 30323).

TYPE. — The female (32.0 mm cl) (USNM 30323) collected by the *"Albatross"*, stn 4174, off Niihau I., 1323-1557 m, is the holotype of *Polycheles asper* Rathbun, 1906.

DESCRIPTION. — Dorsal surface of carapace densely covered with slender antrorse spinules. Frontal margin slightly concave. Internal angle of orbital sinus bearing slender spine. Outer orbital margin pectinate. Eyestalk bearing vermicular process, pointing distad. Antennular segment bearing three closely set spines on antero-external angle. Spine formula of lateral margins of carapace 14-15:8-10:28-29. Median postrostral and postcervical carinae bearing irregular double row of antrorse spinules, blunter behind cervical groove. Gastro-orbital region without carina. Branchial carina sinuous, minutely spinulose. Diagonal groove anteriorly between median postcervical and branchial carinae. Posterior margin of cervical groove minutely spinulose. Posterior margin of carapace smooth.

Abdominal tergites sculptured, granulate. Tergites 2-5 with deep, transversely oblique grooves on each side of blunt median carina. Sixth tergite bearing obsolescent, beaded, lyre-shaped carina mesially, low granules laterally. Second pleuron cordiform, with short groove mesially; pleura 3-4 with short rib mesially. Telson margins serrulate, uropods smooth.

REMARKS. — RATHBUN (1906: 899) had not recognized that the single, juvenile *asper* differs much from other polychelid species: "This species has the form of *P. granulatus* Faxon, but the dorsal surface is much rougher, the

Source : MNHN, Paris

carapace more convex, its side margins more finely and obscurely cut, abdominal carinae, except the seventh, nonprojecting, antennal scale rounded at tip instead of pointed".

H. asper differs from its congener in having blunt abdominal carinae rather than bicuspid, the second pleuron cordiform rather than reniform, smooth uropods rather than granulate, and the lateral margins of carapace posterior to postcervical incision cristate and serrulate rather than rounded, bearing several irregular rows of robust, antrorse spinules.

DISTRIBUTION. — Known only from the type specimen, collected in Hawaii, between 1323-1557 m.

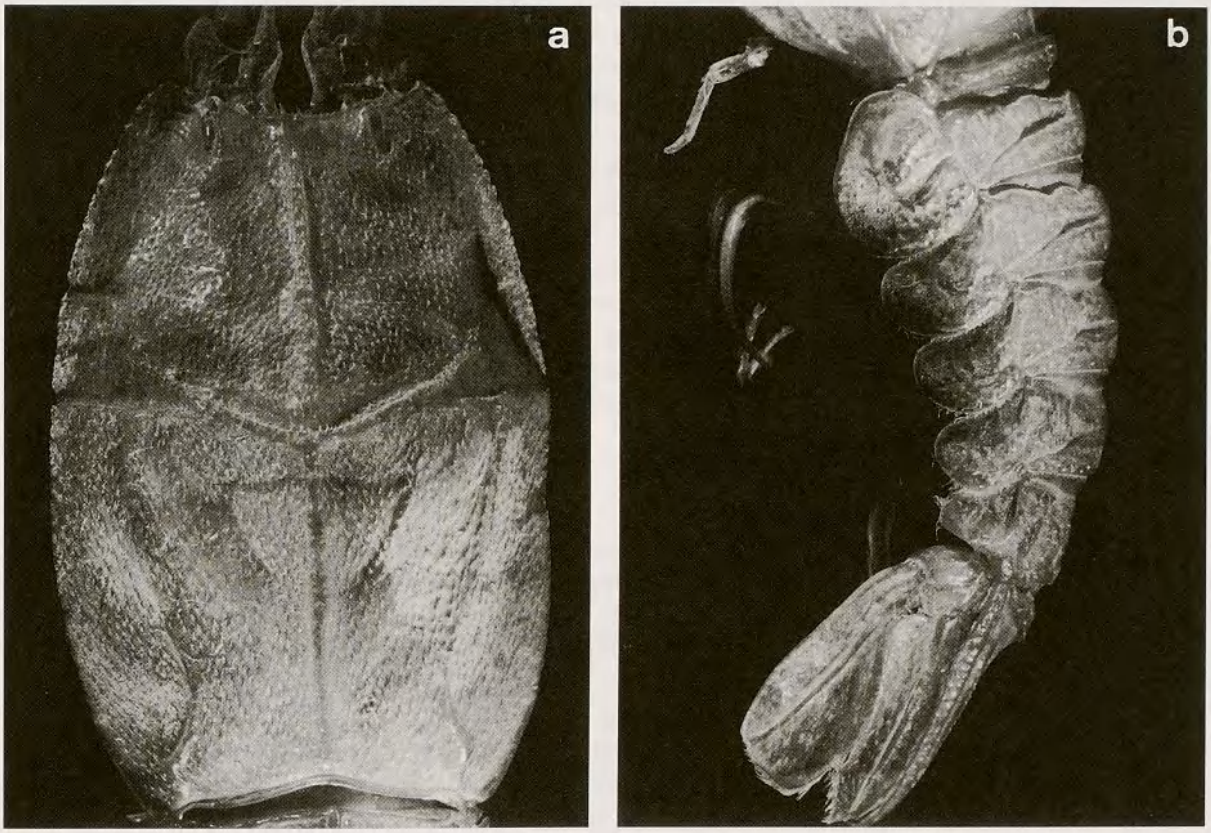

FIG. 6. — *Homeryon asper* (Rathbun, 1906), ♀ 32.0 mm, holotype, Hawaii, *"Albatross"* stn 4174, 1323-1557 m (USNM 30323): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

Genus ***PENTACHELES*** Bate, 1878

Pentacheles Bate, 1878a: 276.

TYPE SPECIES — *Pentacheles laevis* Bate, 1878, designated by FOWLER, 1912 (*Annual Report of the New Jersey State Museum* for year 1911: 569). Gender masculine.

DIAGNOSIS. — Carapace dorsoventrally flattened, subrectangular or ovate. Anterolateral angle of carapace produced, spiniform. Lateral margins well defined, spinose; cervical and postcervical incisions markedly dividing margin into three parts. Front concave, bearing two rostral spines. Orbital sinus well defined; eyestalk filling orbit, pointing distad.

Cervical groove marked, arcuate, laterally bifurcate. Postrostral and postcervical carinae well defined, granulate or spinose. Postorbital carina obsolescent, branchial carina obsolescent or spinulose.

Source : MNHN, Paris

Abdomen narrow, laterally depressed. First abdominal tergite narrow, pleura fused, abbreviated. Abdominal tergites 2-5 obliquely grooved, medially carinate; carinae blunt or anteriorly spinose; sixth tergite smooth. Second abdominal pleuron larger, clypeiform, smooth; pleura 3-4 cordiform, successively diminishing in size posteriorly; fifth pleuron triangulate. Abdominal sternites with median knob. Telson lanceolate, with median basal tubercle, two submedian carinae. Uropodal exopod lamellar, rounded, grooved; endopod rounded, grooved, basal lappet on interior margin.

Basal antennular segment proximally quadrate, lamellar; mesial margin granulate or spinose, upcurved, anteriorly produced, reaching base of peduncle. Outer antennular flagellum short, inner flagellum as long as antennal flagellum. Renal process well developed, tubular, fitting into hollow on underside of basal antennular segment. Antennal scaphocerite lanceolate, not extending beyond peduncule.

Buccal opening subquadrate. Mandible concave, cutting edge with triangular teeth of uneven size; mandibular palp biarticulate. Maxillula with two incurved lobes, spiniform setae distally on anterior lobe. Maxilla with two slender lobes, internal lobe half as long as lateral; large scaphognathite. First maxilliped endopod slender, exopodal lobe membraneous, reniform, extending further back than scaphognathite, exopod anteriorly divided into two lobes enclosing efferent passage. Second and third maxillipeds, slender, pediform; third maxilliped epipod longer than ischium; dactyl as long as propodus.

Pereiopods 1-4 chelate, P5 chelate in female, subchelate in male. P1 larger, more robust than P2-5; pereiopods successively shorter posteriorly. Fingers of first and second chelipeds crossing, their inner margin furnished with row of overlapping cornute platelets, forming serrate edge. Fingers of chelae of P3-4 slightly upcurved. First male pleopod spatuliform, spinulose, swelling distally on inner margin, spinules distally on mesial margin, distal margin folded internally. P2-6 biramose, with rod-like appendix interna; second pair in male with appendix masculina.

ETYMOLOGY. — From Greek, *pente* (= five) and *chele* (= claw) referring to the chelae of all five pereiopods.

REMARKS. — BATE established *Pentacheles* for species where "All the pereiopoda are more or less perfectly chelate in both sexes" (BATE, 1888: 143). However, all species (*agassizii, euthrix, gracilis, laevis, obscura, sculptus, validus*) put into *Pentacheles* by BATE (1888) have males with fifth pereiopod simple or subchelate. ALCOCK (1901b: 165) characterized *Pentacheles* as having "epipodite of the external maxillipeds .....of fair size". This does not correspond with *Pentacheles* as described by BATE (1878a), and further, ALCOCK, mistakenly included *hextii*, a junior synonym of *Polycheles typhlops*, in his *Pentacheles*. KEMP & SEWELL (1912), SELBIE (1914), DE MAN (1916) rejected *Pentacheles* and it fell into disuse early in this century.

Pentacheles is distinguished from the closely related *Polycheles* in having third maxilliped epipod longer than ischium, proximally quadrate basal antennular segment, whereas *Polycheles* has rudimentary epipod and rounded basal antennular segment.

Pentacheles gibbus Alcock, 1894

Pentacheles sp. - WOOD-MASON, 1891: 19.
Pentacheles gibba Alcock, 1894: 234. — WOOD-MASON & ALCOCK, 1894, pl. 8 fig. 4. — ANDERSON, 1896: 98.
Polycheles gibba - ALCOCK, 1899: 33.
Pentacheles gibbus - ALCOCK, 1901b: 173.
Polycheles gibbus - DE MAN, 1916: 5. — BERNARD, 1953: 86. — HOLTHUIS, 1984: 4. — FIRTH & PEQUEGNAT, 1971: 46. — DAWSON, 1997: 10.

MATERIAL EXAMINED. — **Andaman Sea**. *"Investigator"*: stn 114, 13°21'N, 93°27'E, 1687 m, 13.11.1890: 1 juv. (IM 6799/10); 1 juv. (IM 6800/10).
Arabian Sea. *"Investigator"*: stn 192, 15°11'N, 72°28'45"E, 1668-1703 m, 14.01.1895: 1 ♂ 62.0 mm (IM 46/10); 1 juv. 26.0 mm (IM 792/10).

TYPE. — The juvenile (IM 6799/10) collected by the *"Investigator"*, stn 114, in the Andaman Sea is the holotype, the other juvenile in the sample is a paratype.

Source : MNHN, Paris

DESCRIPTION. — Carapace convex, gibbous; lateral margins convergent anteriorly and posteriorly. Dorsal surface of carapace thickly tomentose, minutely granulose. Anterior margin of carapace sinuous, bearing small, bifid rostral spine. Internal and external angles of orbital sinus unarmed. Eyestalk with small spine directed upward. Basal antennular segment foliaceous; mesial margin raised above rostrum, irregularly granulate; single spine on antero-external angle. Spine formula of lateral margins of carapace 5-6:3:16-19; spines diminish considerably in size posteriorly, posteriormost no more than granules. Median postrostral carina irregularly granulate, median postcervical carina with two rows of antrorse spinules. Gastro-orbital region unarmed. Branchial carina sinuous, obsolescent. Posterior margin of carapace smooth.

Abdominal tergites set with prominent conic granules, medially carinate. Carinae on tergites 2-5 bicuspid. Sixth tergite set with prominent conic granules on each side of short crest. Tergites 2-5 bearing well-defined, transversely oblique submedian grooves. Pleura set with prominent conic granules. Second pleuron anteriorly produced, ovate. Telson with granulate tubercle medially, two smooth submedian carinae posteriorly, margins minutely spinulate.

First pereiopod remarkably short, smooth except for subterminal spines on upper margin of merus, chela and lower margin of carpus. Merus proximally dilated. Carpus 3/4 as long as merus. P5 subchelate in male. Female unknown.

Color. — "bright pink" (ALCOCK, 1894: 235).

REMARKS. — *P. gibbus* is distinguished from the closely related *P. obscurus* in its humped carapace and prominent conic granulation on abdominal terga and pleura.

No photograph is available as the author was prohibited from photographing in the Indian Museum.

DISTRIBUTION. — Andaman Sea, Arabian Sea; 1668-1703 m.

Pentacheles laevis Bate, 1878

Fig. 7

Pentacheles laevis Bate, 1878a: 278; 1878b: 484; 1878c: 563; 1888: 144, pl. 15 figs 4c, 5. — FAXON, 1895: 118. — MURRAY, 1897: 388. — DE MAN, 1916: 5 (list). — SUND, 1920: 224. — ESTAMPADOR, 1937: 497; 1959: 43.

Pentacheles gracilis Bate, 1878a: 279; 1878b: 484; 1878c: 563; 1888: 146, pl. 16 figs 1-2. — FAXON, 1895: 118. — SUND, 1920: 224. — BERNARD, 1953: 86.

Polycheles granulatus Faxon, 1893: 197; 1895: 123, pl. 32 fig. 1, pl. 33 figs 2, 2a. — RATHBUN, 1906: 899, fig. 54. — STEBBING, 1910: 378. — SELBIE, 1914: 23, pl. 3 figs 1-2. — DE MAN, 1916: 5 (list). — BOUVIER, 1917: 45, pl. 2 figs 7-14. — STEPHENSEN, 1923: 67. — BALSS, 1925: 200. — CALMAN, 1925: 18. — MIRANDA & RIVERA, 1933: 17. — LE DANOIS, 1948: 150 (list). — BARNARD, 1950: 569. — BERNARD, 1953: 86. — SQUIRES, 1965: 89, fig. 38; 1966: 2. — ALLEN, 1967: 55. — ZARIQUIEY, 1968: 210. — ZARENKOV, 1969: 81. — FIRTH & PEQUEGNAT, 1971: 47. — THIRIOT, 1974: 344. — TÜRKAY, 1976: 27. — WENNER, 1979: 443. — WENNER & BOESCH, 1979: 111. — BEAUBRUN, 1979: 39, figs 17-18. — KENSLEY, 1981b: 29. — POHLE, 1985: 22. — SQUIRES, 1991: 355, figs 187-188. — LEMAITRE & ALVAREZ-LEON, 1992: 33. — FALCIAI & MINERVINI, 1992: 134. — GONZALEZ, 1995: 126. — GRIFFIN & STODDART, 1995: 240, figs 4-5. — HENDRICKX, 1995: 156. — DAWSON, 1997: 10.

Pentacheles beaumontii Alcock, 1894: 236; 1901b: 175. — WOOD-MASON & ALCOCK, 1894, pl. 8 fig. 3.

Polycheles beaumontii - FAXON, 1895: 125. — ALCOCK, 1899: 33. — BOUVIER, 1905b: 644; 1905d: 2. — HOLTHUIS, 1984: 4.

Polycheles dubius Bouvier, 1905a: 480; 1905c: 4. — RICHARD, 1905: 3; 1907: 322.

Polycheles eryoniformis Bouvier, 1905b: 644; 1905d: 2; 1907: 62.

Polycheles gracilis - DE MAN, 1916: 5 (list). — BOUVIER, 1917: 35. — FIRTH & PEQUEGNAT, 1971: 46.

Polycheles laevis - FIRTH & PEQUEGNAT, 1971: 49. — DAWSON, 1997: 12.

Polycheles aff. *gracilis* - MACPHERSON, 1984: 74.

not *Polycheles beaumontii* - STEBBING, 1908: 25; 1910: 377 [= *Polycheles validus* (A. Milne Edwards, 1880)].

MATERIAL EXAMINED. — **Ibero-Morrocan Gulf**. BALGIM: stn CP 98, 34°29'N, 7°42'W, 1721-1773 m, 9.06.1984: 2 juvs (MNHN-Pa 1358).

Azores. *"Travailleur"*: 44°04'N, 9°81'W, 1600 m, 12.07.1882: 1 juv. damaged (MNHN-Pa 1138).

"Hirondelle": 39°27'N, 33°29'W, 1557 m, 30.07.1888: 1 ♀ 36.4 mm; 2 juvs (MNHN-Pa 34).

Source : MNHN, Paris

CANCAP 5: stn 5.005, 37°55'N, 24°46'W, 1650-2050 m, 24.05.1981: 1 juv. (RMNH). — Stn 5.090, 38°09'N, 28°31'W, 1320-1350 m, 2.06.1981: 1 ♂ 35.3 mm; 1 ♀ 37.8 mm; 1 juv. (RMNH).

Canary Is. CANCAP 4: stn 4.057, 28°47'N, 13°24'W, 1300-1335 m, 19.05.1980: 1 ♂ 48.0 mm (RMNH). — Stn 4.102, 29°08'N, 13°19'W, 1290 m, 23.05.1980: 1 ♀ 34.6 mm (RMNH).

Cape Verde Is. CANCAP 6: stn 6.049, 14°52'N, 24°32'W, 1100-1300 m, 10.06.1982: 2 juvs. (RMNH). — Stn 6.050, 14°53'N, 24°32'W, 1100-1200 m, 10.06.1982: 1 ♂ 54.1 mm (RMNH). — Stn 6.055, 15°46'N, 22°33'W, 950-1040 m, 12-13.06.1982: 2 ♂ 45.8, 37.7 mm (RMNH). — Stn 6.065, 15°58'N, 22°33'W, 950-1040 m, 12-13.06.1982: 2 ♂ 45.8, 37.7 mm (RMNH).

SE Atlantic. Rio Grande Ridge. *"Prof. Mesyatsev"*: 12.07.1974, coll. B.N. KOTENEV: 2 ♂ 36.5, 39.8 mm; 1 ov. ♀ 56.0 mm; 1 juv. (ZMMU).

SE Atlantic. Discovery Seamount. *"Prof. Mesyatsev"*: stn 154, 760 m, 10.12.1979, coll. M.V. BONDARENKO: 1 ♂ 33.7 mm; 1 juv. (ZMMU).

United States. *"Gillis"*: stn 83, 36°41'N, 74°29'W, 1500-1350 m, 9.11.1974: 1 juv. (USNM 314136).

Bahama Is. *"Gerda"*: stn 182, 27°55'N, 78°40'W, 860-897 m, 2.07.1963: 1 ♀ 55.4 mm (RMNH 25834).

Panama. *"Albatross"*: stn 3380, 4°03'N, 81°31'W, 1645 m, 5.03.1891: 1 ♀ 44.2 mm (MCZ 4578).

Galapagos Is. *"Albatross"*: stn 4641, Hood I., 01°35'S, 89°30'W, 1139 m, 7.11.1904: 1 juv. (USNM).

Nazca Ridge. *"Prof. Mesyatsev"*: 25°51'S, 84°34'W, 1050 m, 5.09.1983: 1 ♂ 55.2 mm (ZMMU). — Stn 44, 20°44.9'S, 80°52.3'W, 18.09.1983: 1 ♀ 39.3 mm (ZMMU)

Hawaiian Is. *"Albatross"* (id. M.J. RATHBUN as *P. granulatus*): stn 3887, Molokai I., 21°16'30"N, 156°29'55"W, 997-1456 m, 17.04.1902: 1 ♀ 23.7 mm (USNM 30321). — Stn 3989, Kauai I., 22°05'55"N, 159°16'50"W, 900-693 m, 11.06.1902: 1 juv. (USNM 30315). — Stn 4007, btw. Honolulu and Kauai I., 21°50'20"N, 159°31'40"W, 914-1003 m, 17.06.1902: 1 ♀ 23.0 mm (USNM 30319). — Stn 4019, Kauai I., 22°05'15"N, 159°17'W, 990-736 m, 21.06.1902: 1 juv. (USNM 30315). — Stn 4111, Kaiwi Channel, 21°24'40"N, 157°23'55"W, 841-860 m, 24.07.1902: 1 ♂ 50.1 mm; 1 juv. (USNM 30320). — Stn 4138, Oahu, 22°00'N, 159°19'20"W, 857-788 m, 1.8.1902: 2 juvs (USNM 30318).

Marquesas Is. Eiao I., MUSORSTOM 9: stn CP 1278, 75°2'S, 140°39'W, 1000 m, 5.09.1997: 2 ♀ 24.6, 37.5 mm (MNHN).

Wallis & Futuna Is. MUSORSTOM 7: stn CP 592, 12°32'S, 174°22'W, 730-775 m, 24.05.1992: 1 juv. (MNHN-Pa 1655). — Stn CP 623, 12°34'S, 178°15'W, 1280-1300 m, 28.05.1992: 1 juv. (MNHN-Pa 1656).

Fiji Is. *"Challenger"*: stn 174c, Kadavu I., 19°07'50"S, 178°19'35"E, 1098 m, 1 ♀ 24.7 mm (NHM 1888.22).

South Fiji Basin. NZOI: stn Z8880, 30°00.1'S, 177°20.1'E, 29.07.1997, coll. J. WILLS: 1 ♂ 30.3 mm (NIWA).

Vanuatu. MUSORSTOM 8: stn CP 956, 20°33.41'S, 169°35.95'W, 1175-1210 m, 20.09.1994: 1 ♀ 44.2 mm; 1 juv. (MNHN-Pa 1647). — Stn CP 990, 18°51.63'S, 168°50.98'W, 980-990 m, 24.09.1994: 1 ♀ 29.3 mm (MNHN-Pa 1648). — Stn CP 996, 18°52.41'S, 168°55.73'W, 764-786 m, 24.09.1994: 1 ♀ 49.8 mm (MNHN-Pa 1649). — Stn CP 1037, 18°03.70'S, 168°54.40'W, 1058-1086 m, 29.09.1994: 1 ♂ 32.8 mm (MNHN-Pa 1650). — Stn CP 1112, 14°52.57'S, 167°11.89'W, 961-950 m, 8.10.1994: 1 juv. (MNHN-Pa 1651).

New Caledonia. BIOCAL: stn CP 30, 23°09'S, 166°41'E, 1140 m, 29.08.1985: 1 ♀ 37.6 mm; 3 juvs (MNHN-Pa 1657). — Stn CP 31, 23°08'S, 166°51'E, 850 m, 29.08.1985: 1 ♀ 56.2 mm; 2 juvs (MNHN-Pa 1658). — Stn CP 32, 23°07'S, 166°51'E, 825 m, 29.08.1985: 1 ♂ 47.2 mm, 1 juv. (MNHN-Pa 1659). — Stn CP 54, 23°10'S, 167°43'E, 950-1000 m, 1.09.1985: 1 ♂ 37.8 mm (MNHN-Pa 1660).

BIOGEOCAL: stn CP 290, 20°36.91'S, 167°03.34'E, 920-760 m, 04.1987: 1 ♂ 46.1 mm (MNHN-Pa 1750).

VOLSMAR: stn CP 26, 22°22.8'S, 171°21.4'E, 980 m, 4.06.1989: 1 ♂ 48.4 mm (MNHN-Pa 1662).

BATHUS 1: stn CP 651, 21°41.8'S, 166°40.1'E, 1080-1180 m, 11.03.1993: 1 ♂ 22.7 mm (MNHN-Pa 1663). — Stn CP 661, 21°05'S, 165°50.05'E, 960-1100 m, 13.03.1993: 1 ♀ 44.9 mm (MNHN-Pa 1664).

BATHUS 2: stn CP 767, 22°10.47'S, 165°59.10'E, 1060-1450 m, 17.05.1993: 4 ♂ 22.1-33.7 mm; 1 ♀ 22.7 mm (MNHN-Pa 1665).

BATHUS 3: stn CP 844, 23°60.38'S, 16°45.60'E, 908 m, 1.12.1993: 1 ♀ 58.3 mm (MNHN-Pa 1666).

BATHUS 4: stn CP 951, 20°31.44'S, 164°54.57'E, 960 m, 10.08.1994: 1 juv. 16.6 mm (MNHN-Pa 1667).

HALIPRO 1: stn 867, 21°26.15'S, 166°18.17'E, 720-950 m, 22.03.1994: 1 ♂ juv. 24.9 mm (MNHN-Pa 1668). — Stn 874, 23°05'S, 166°48'E, 708-830 m, 30.03.1994: 1 ♀ 57.0 mm (MNHN-Pa 1669). — Stn 876, 23°10.41'S, 166°49.16'E, 870-1000 m, 31.03.1994: 2 ♀ 52.9, 63.4 mm (MNHN-Pa 1670); 2 ♂ juvs 22.7, 26.4 mm.

HALIPRO 2: stn BT 41, 25°51'S, 167°12'E, 1317-1383 m, 14.11.1996: 2 ♀ 36.5, 60.4 mm (MNHN-Pa 1689). — Stn BT 69, 24°40'S, 168°09'E, 943-1080 m, 19.11.1996: 1 ♀ 38.3 mm (MNHN-Pa 1691). — Stn BT 73, 24°51'S, 167°40'E, 1043-1102 m, 20.11.1996: 1 ♀ 59.6 mm (MNHN-Pa 1692). — Stn BT 85, 23°40'S, 168°05'E, 935-1100 m, 23.11.1996: 1 ov. ♀ 49.3 mm (MNHN-Pa 1693). — Stn BT 97, 24°00'S, 161°49'E, 964-1031 m, 25.11.1996: 4 ♀ 30.7-50.1 mm (MNHN-Pa 1694). — Stn BT 101, 24°19'S, 161°43'E, 970-1063 m, 26.11.1996: 1 ov. ♀ 59.1 mm (MNHN-Pa 1695). — Stn 102, 24°31'S, 161°52'E, 1060-1130 m, 26.11.1996: 1 ♀ 43.2 mm; 1 juv. (MNHN-Pa 1696). — Stn BT 103, 24°54'S, 162°09'E, 1235-1256 m, 26.11.1996: 1 ♀ 24.8 mm, 2 juvs (MNHN-Pa 1697). — Stn BT 104, 25°26'S, 162°27'E, 1118-1124 m, 27.11.1996: 1 ov. ♀ 44.3. mm; 2 juvs (MNHN-Pa 1698).

Chesterfield Is. MUSORSTOM 5: stn 323, 21°18.52'S, 157°57.62'E, 970 m, 14.10.1986: 1 ♂ 44.7 mm; 2 ♀ 48.4, 56.2 mm; 11 juvs (MNHN-Pa 1652). — Stn 324, 21°15.01'S, 157°51.33'E, 970 m, 14.10.1986: 2 ♂ 22.8, 42.3 mm;

Source : MNHN, Paris

1 ♀ 53.7 mm; 6 juvs (MNHN-Pa 1653). — Stn 326, 21°07.40'S, 157°47'E, 980 m, 14.10.1986: 1 ♂ 33.5 mm (MNHN-Pa 1654).

Indonesia. *"Challenger"*: stn 214, Molucca Sea, 4°33'N, 127°06'E, 914 m, 10.02.1875: 1 ♀ 17.9 mm (NHM 1888.22).

"Albatross": stn 5601, Sulawesi, 1°13.10'N, 125°17.05'E, 1377 m, 13.11.1909: 1 ♀ 23.1 mm; 2 juvs (USNM).

Philippines. *"Albatross"*: stn 5127, Panay, 10°22'45"N, 121°48'15"E, 1724 m, 4.02.1908: 1 ♂ 23.4 mm (USNM). — Stn 5428, Palawan, 9°13'N, 118°51'15"E, 1989 m, 3.04.1909: 1 ♂ 24.6 mm; 2 ♀ 25.1, 39.6 mm; 7 juvs (USNM). — Stn 5468, Lagonoy Gulf, San Bernardino Str., 13°35'39"N, 123°40'28"E, 1024 m, 18.06.1909: 1 ♀ 35.9 mm (USNM).

MUSORSTOM 2: stn CP 56, 13°54'S, 119°57'E, 970 m, 28.11.1980: 1 ♀ 44.1 mm (MNHN-Pa 1741).

Australia. *New South Wales. "Kapala"*: stn K79-20-06, 33°36'S, 152°06'E, 914 m, 4.12.1979, id. H.E. STODDART as *Polycheles granulatus*: 1 ♀ 52.7 mm (AM P44898). — 33°30'S, 152°10'E, 880 m, Nov. 1992, id. H.E. STODDART as *Polycheles granulatus*: 1 ♂ 43.7 mm; 1 ♀ 52.4 mm (AM P44908).

Tasmania. Off St. Patrick's Head, 920 m, 24.07.1983, coll. R.M. GREEN: 1 ♂ 40.2 mm (TM G3278). — 41°14'S, 148°45'E, 950 m, 17.06.1991, coll. R. BREWSTER: 1 ov. ♀ 42.3 mm (TM G3489).

Tasman Sea. *Lord Howe Rise*. NZOI: stn U 197, 34°09.8'S, 163°36.7'E, 1186 m, 25.9.1982: 1 juv. (NIWA).

New Zealand. NZOI: stn V 370, 42°41.70'S, 179°03.42'W, 1024 m, 12.09.1989: 1 ♀ 24.1 mm (NIWA). — Stn X 508, 42°51.86'S, 174°56.10'W, 1163-1173 m, 9.07.1994: 1 ♂ 30.7 mm (NIWA). — Stn Z8445, 44°01'S, 160°37'W, 1000 m, 23.08.1995: 1 ♀ 54.7 mm (NIWA).

Madagascar. *"Vauban"*: stn CH 131, 13°46'S, 47°33'E, 1490-1600 m, 20.01.1975: 3 juvs (MNHN-Pa 1742).

TYPES. — The juvenile female (17.9 mm cl) (NHM 1888.22) collected by the *"Challenger"* stn 214, off the Moluccas (4°33'N, 127°6'E, 914 m), is the lectotype of *Pentacheles laevis* Bate, 1878, designated by SUND (1920: 225).

The female (24.7 mm cl) (NHM 1888.22) collected by the *"Challenger"* stn 174c, off Fiji (19°07.50'S, 178°19.35'E, 1098 m), is the holotype of *Pentacheles gracilis* Bate, 1878.

The female (44.2 mm cl) (MCZ 4578) collected by the *"Albatross"* stn 3380, off Panama (43'N, 81°31'W, 1645 m), is the holotype of *Polycheles granulatus* Faxon, 1893.

The male (44.0 mm cl) (IM 520/7) collected by the *"Investigator"* off Colombo, Sri Lanka, at a depth of 1234 m, is the holotype of *Pentacheles beaumonti* Alcock, 1894.

The female (36.4 mm cl) (MNHN-Pa 34) collected by the *"Hirondelle"*, off the Azores, is designated here as the lectotype of *Polycheles dubius* Bouvier, 1905; the two juvenile specimens of this sample and a juvenile collected by the *"Travailleur"* (MNHM-Pa1138) are paratypes.

DESCRIPTION. — Carapace ovate. Dorsal surface of carapace granulose, sparsely setose. Anterior margin of carapace slightly concave, two long rostral spines adjoining at base. Internal and external angles of orbital sinus prominently produced, spinose. Eyestalk bearing spine, curved distad. Basal antennular segment lamellar, produced anteriorly to an acute point; mesial margin prominently spinose; single spine on antero-external angle. Lateral margins of carapace lined with upcurved spines, anteriormost spine largest, diminishing gradually in size posteriorly; spine formula 7-9:3-4:14-15. Median postrostral carina bearing irregular number of spines followed by close-set granules; median postcervical carina with two rows of antrorse, mammilate tubercles. Gastro-orbital region unarmed. Posterior margin of cervical groove unarmed. Branchial carina sinuous, spinulate; spinules increasing in size posteriorly. Posterior margin of carapace smooth.

Abdominal tergites medially carinate; carinae on tergites 1-3 bearing antrorse beak; tergites 4-5 with blunt carina; sixth tergite noncarinate; tergites 2-5 with well defined, oblique submedian grooves. Surface of pleura smooth, minutely punctate; anterior pleuron with mesial groove proximally; following pleura bearing short, obsolescent mesial rib; margins smooth. Telson with rounded tubercle anteriorly, two smooth, confluent carinae posteriorly.

Merus of cheliped finely granulate on upper margin with a subterminal claw; lower margin spinulate, spines increasing in size proximally. Carpus nearly as long as merus, claw-like spine on interior and exterior margins. Upper margin of chela with two (or more) serrulate rows, interior row with largest spines, claw-like subterminal spine; lower margin with single serrulate row. P5 subchelate in male, chelate in female.

Color. — "Entire carapace, abdominal segments and telson light rose pink, spines tipped with white. Antennular and antennal flagella and peduncles, pereopods, pleopods, endopods and exopods of uropods a darker

Source : MNHN, Paris

pink to red." (GRIFFIN & STODDART, 1995: 242). BOUVIER's (1917: 150, fig. 7) colored drawing was done "d'après des aquarelles exécutées au moment de la capture".

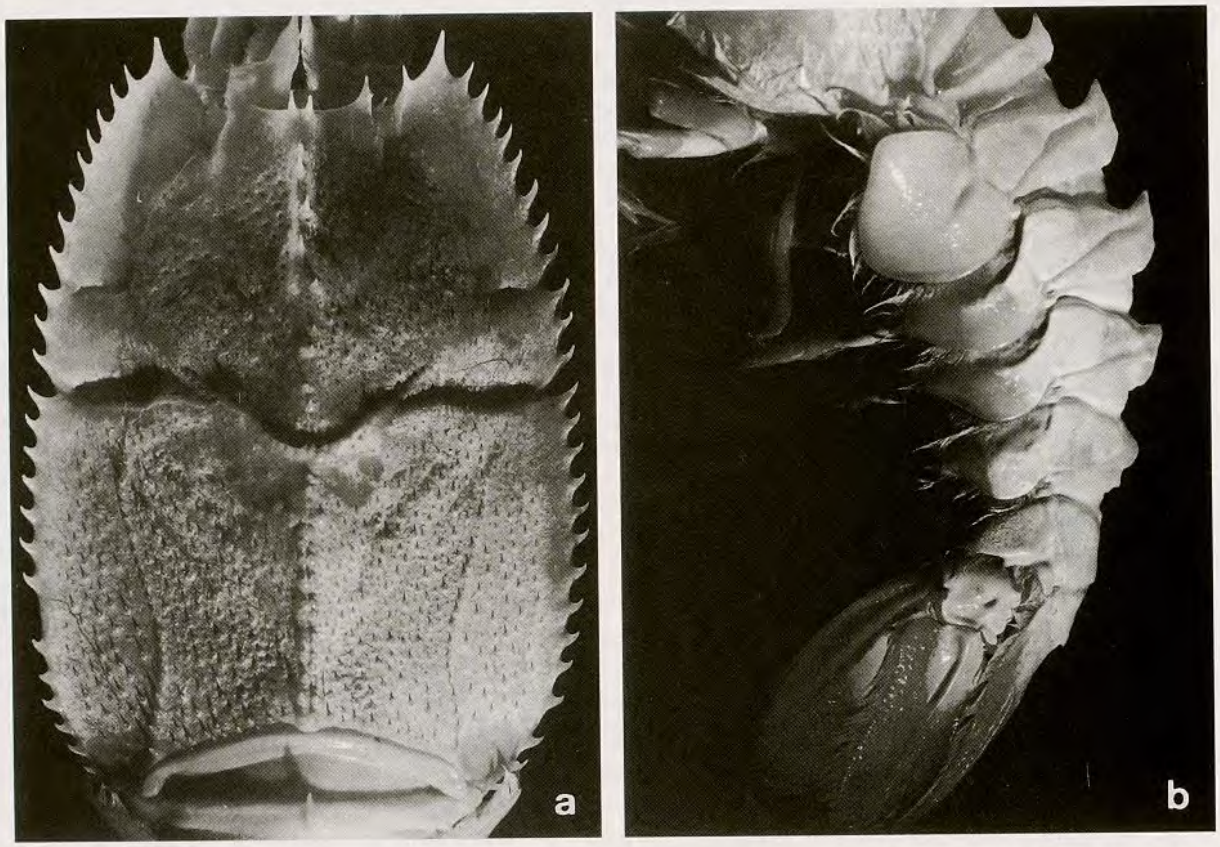

FIG. 7. — *Pentacheles laevis* Bate, 1878, ♂ 42.3 mm, New Caledonia, MUSORSTOM 5, stn 324, 21°15.01'S, 157°51.33'E, 970 m (MNHN-Pa 1653): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

REMARKS. — *P. laevis* is easily distinguished from *P. validus* in having fewer postcervical lateral spinules, bearing prominent spines anteriorly on the median carina, lacking the gastro-orbital spines, and lacking spines on the posterior margin of the cervical groove.

The single female specimen of *Pentacheles laevis* was "not a very perfect one" (BATE, 1888: 146) and was inaccurately described and inadequately drawn. Though a juvenile, as evinced from its subchelate fifth pereiopod, the ovate carapace, the prominently produced internal and external angles of the orbital sinus, the spinose mesial margin of the basal antennular segment, the single spine on its antero-external angle, and the form of the median abdominal carinae leave no doubt as to its identity. BATE's (1888) description of *P. gracilis* was based on a slightly larger specimen, but the accompanying drawing (pl. 16) has erroneously depicted the frontal margin much produced and was criticized by SUND (1920). However, it was FAXON's (1893) description of *P. granulatus* that was favoured by most subsequent authors. FAXON himself (1895: 124) observed: "This species [*P. granulatus*] somewhat resembles *P. laevis* (Bate), *P. validus* (A.M. Edw.), and *P. debilis* (Smith)... an East Indian species, *Polycheles beaumontii*, bears the closest likeness to *P. granulatus*. Indeed the resemblance between these two forms is so great that I am inclined to regard *P. beaumontii* as, at most, but a geographical race of *P. granulatus*" - scoring three out of four synonymies. SELBIE (1914: 25), following RATHBUN (1906), wrote "no doubt that *P. beaumontii*, Alcock, is merely a synonym of *P. granulatus*, Faxon". BOUVIER (1905a: 481) described *P. dubius* "elle se distingue par l'atrophie complète des carènes exogastriques, par ses carènes exocardiaques faiblement indiquées, par le bord postérieur inerme de la carapace, par la forte saillie aiguë qui limite en dedans et en dehors chaque sinus orbitaire, par les carènes obtuses et peu saillantes de ses tergites abdominaux 4 et 5, par l'absence de

Source : MNHN, Paris

tout dessin sur le tergite 6" - a perfect description of *laevis*. SELBIE (1914: 25) recognized that "*P. dubius* (Bouvier) is also clearly a synonym of *P. granulatus*." BOUVIER (1917: 51) conceded that :"une étude plus sérieuse me donne la certitude que toutes ces formes [*P. dubius, P. eryoniformis*] doivent être identifiées avec le *P. granulatus*." - indeed with *laevis*.

DISTRIBUTION. — Worldwide; SW Ireland, Ibero-Morrocan Gulf, Madeira, Canary Is, Azores, Cape Verde Is, Mid-Atlantic bight, southwestern Atlantic, Rio Grande Ridge, Newfoundland, Nova Scotia, United States, Bahama Is, Gulf of Panama, Colombia, Galapagos Is, Nazca Ridge, Marquesas Is, Hawaii, Fiji, Wallis & Futuna Is, Vanuatu, New Caledonia, New Zealand, Tasmania, Australia, Indonesia, Molluca Sea, Philippines, Sri Lanka, Madagascar; 347 m (DAWSON, 1997) - 2505 m (ALCOCK, 1899).

Pentacheles obscurus Bate, 1878

Fig. 8

Pentacheles obscura Bate, 1878a: 279; 1878b: 484; 1878c: 563; 1888: 143, pl. 15 fig. 2. — PAGENSTECHER, 1879: 63. — FAXON, 1895: 12.
Pentacheles carpenteri Alcock, 1894: 235; 1901b: 174. — ALCOCK & ANDERSON, 1895, pl. 10 fig. 1.
Polycheles carpenteri - ALCOCK, 1899: 33. — DE MAN, 1916: 23, pl. 1 fig. 3. — BOUVIER, 1917: 35. — BERNARD, 1953: 86. — ZARENKOV, 1969: 81. — FIRTH & PEQUEGNAT, 1971: 42. — DAWSON, 1997: 7.
Polycheles obscurus - DE MAN, 1916: 5 (list). — BERNARD, 1953: 86. — FIRTH & PEQUEGNAT, 1971: 49. — DAWSON, 1997: 12.

MATERIAL EXAMINED. — **Wallis and Futuna Is area**. MUSORSTOM 7. *SW Combe Bank*: stn CP 622, 12°34'S, 178°11'W, 1280-1300 m, 28.05.1992: 1 ♀ 55.6 mm (MNHN-Pa 1671).

New Caledonia. BIOGEOCAL: stn CP 260, 21°00'S, 166°58.34'E, 1820-1980 m, 17.04.1987: 1 ♀ 43.2 mm (MNHN-Pa 1743).

BATHUS 1: stn CP 704, 20°55.8'S, 165°38.6'E, 1100-1200 m, 18.03.1993: 1 ♂ 39.0 mm (MNHN-Pa 1672).

New Guinea. *"Challenger"*. stn 218, 2°33'S, 144°4'E, 1857 m, 1.03.1875: 1 juv. (damaged) (NHM 1888.22).

Indonesia. *"Siboga"*: stn 126, Molucca Sea, 3°27.1'N, 125°18.7'E, 2053 m, 20.07.1899, id. DE MAN as *Polycheles carpenteri* : 1 ♂ 39.8 mm (ZMA).

"Galathea": stn 471, off the south coast of Java, 10°26'S, 114°15'E, 3080 m, 10.09.1951: 1 ♀ 20.8 mm (ZMC).

Gulf of Aden. *"Meteor 5"*: stn Me5-257, 13°06.6'N, 47°0'E, 2227-2250 m, 11.03.1987: 1 ♀ 29.4 mm (SMF 24659). — Stn Me5-271, 12°56.7'N, 47°47.0'E, 2276-2282 m, 14.03.1987: 2 ♀ 43.9, 32.3 mm; 1 juv. (SMF 24660).

Madagascar. *"Vauban"*: CH 138, 13°48.8'S, 47°29'E, 1800-2000 m, 27.02.1975, coll. A. CROSNIER: 1 ♂ 50.2 mm (MNHN-Pa 1673).

TYPES. — The damaged juvenile (NHM 1888.22) collected by the *"Challenger"* stn 218, off New Guinea (2°33'S, 144°4'E, 1857 m), is the holotype of *Pentacheles obscurus* Bate, 1878.

The female (38.5 mm cl) (IM 76/7) collected by the *"Investigator"* off Carpenter's Ridge, Bay of Bengal, at depths of 2505-2616 m, is the holotype of *Pentacheles carpenteri* Alcock, 1894.

DESCRIPTION. — Carapace ovate, lateral margins convergent anteriorly and posteriorly. Dorsal surface of carapace thickly tomentose, minutely granulose laterally. Anterior margin of carapace sinuous, bearing small, bifid rostral spine. Internal and external angles of orbital sinus unarmed. Eyestalk with small spine directed upward. Basal antennular segment foliaceous, mesial margin raised above rostrum, irregularly granulate; single spine on antero-external angle. Spine formula of lateral edges of carapace 5:3:27-28; spines diminish considerably in size posteriorly, posteriormost no more than granules. Median postrostral carina irregularly granulate anteriorly, median postcervical carina bearing two rows of antrorse granules. Gastro-orbital region unarmed. Branchial carina sinuous, obsolescent. Posterior margin of carapace smooth.

Abdominal tergites medially carinate; carinae on tergites 2-5 bicuspid; sixth tergite with short crest posteriorly. Tergites 2-5 bearing well-defined, transversely oblique, submedian grooves. Pleura nearly smooth; second pleuron anteriorly produced, ovate. Telson with granulate tubercle medially, two smooth submedian carinae posteriorly.

First pereiopod remarkably short, smooth except for subterminal spines on upper margin of merus, palm and lower margin of carpus; merus proximally thickened; carpus 3/4 as long as merus. P5 subchelate in male, chelate in female.

Source : MNHN, Paris

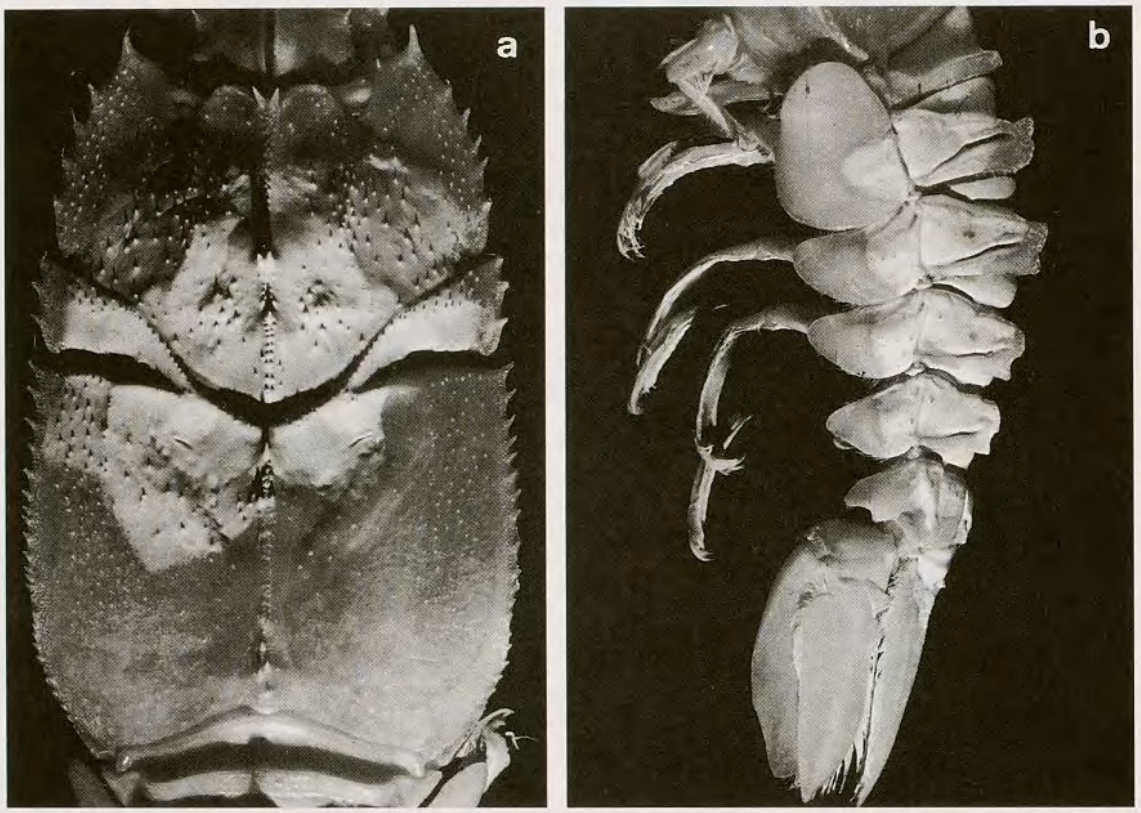

FIG. 8. — *Pentacheles obscurus* Bate, 1878, ♂ 50.2 mm, Madagascar, 13°48.8'S, 47°29'E, 1800-2000 m (MNHN-Pa 1673): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

REMARKS. — The female holotype of *Pentacheles obscurus* was described by BATE (1878a: 279) as being "in a very imperfect condition". Though a juvenile, as evident from its subchelate fifth pereiopod, the densely tomentose carapace, the single spine on the antero-external angle of the basal antennular segment, the shallow orbital sinus, the bicuspid carinae on the abdominal tergites, and the remarkably short first pereiopod with proximally thickened merus and elongate carpus, leave no doubt that *P. carpenteri* Alcock (1899) is synonymous with *P. obscurus*.

DISTRIBUTION. — Melanesia, New Caledonia, New Guinea, Molluca Sea, Madagascar, Gulf of Aden; 1100-3080 m.

Pentacheles snyderi (Rathbun, 1906)

Fig. 9

Polycheles snyderi Rathbun, 1906: 898, pl. 24 fig. 9. — DE MAN, 1916: 6 (list). — BERNARD, 1953: 86. — FIRTH & PEQUEGNAT, 1971: 50. — DAWSON, 1997: 12.

MATERIAL EXAMINED. — **Bay of Biscay**: *"Thalassa"*: stn 448, 48°45.0'N, 11°19.8'W, 1830-1870 m, 1973: 1 ♂ 26.0 mm; 1 juv. (MNHN-Pa 358). — Stn 453, 48°34.0'N, 10°51.6'W, 1975-2070 m, 1973: 1 ♂ 21.1 mm (MNHN-Pa 359).

BIOGAS III, CV 23: stn 1, 47°32.70'N, 8°34.20'W, 2034 m, coll. IFREMER: 1 ♂ 21.8 mm; 1 ♀ 26.8 mm (MNHN-Pa 540). — CV 32: stn 6, 44°07.60'N, 4°15.80'W, 2245 m, coll. IFREMER: 1 juv. (MNHN-Pa 548).

BIOGAS XI, CP 37: stn 1, 47°33.80'N, 47°34.27'W, 11.10.1981, 2175 m, coll. IFREMER: 1 damaged (MNHN-Pa 1138).

Hawaiian Is. *"Albatross"*: stn 4151, vicinity of Modu Manu, 573-1463 m, 7.08.1902: 1 ♂ 34.5 mm (USNM 30333).

Source : MNHN, Paris

Ohau. 21°15.30'N, 158°15.20'W, 0-1100 m, 9.09.1977, coll. F. CLARKE: 1 ♂ 36.0 mm (RMNH 32623).

Indian Ocean Ridge. *"Prof. Mesyatsev"*: 11°31.0'S, 88°55.4'E, 1600-1700 m, 18.02.1979, coll. M.G. KARPINSKI: 2 ♂ 36.6, 42.7 mm; 1 ♀ 50.7 mm (ZMMU).

TYPE. — The male (34.5 mm cl) (USNM 30333) collected by the *"Albatross"* stn 4151, off Hawaii, is the holotype of *Polycheles snyderi* Rathbun, 1906.

FIG. 9. — *Pentacheles snyderi* (Rathbun, 1906), ♂ 42.7 mm, Indian Ocean Ridge, *"Prof. Mesyatsev"* 11°31.0'S, 88°55.4'E, 1600-1700 m (ZMMU): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

DESCRIPTION. — Carapace narrow, subrectangular, slightly convergent anteriorly. Dorsal surface of carapace setose, wholly covered with slender spinules. Frontal margin concave, rostral spines adjoining at base. Internal angle of orbital sinus produced, triangular, unispinose, external orbital angle with 3-4 upcurved spines. Eyestalk bearing upcurved spine distad. Basal antennular segment lamellar, produced anteriorly to a sharp point, mesial margin distally spinose, anterolateral angle unispinose. Spines on lateral margins of carapace upcurved, anteriormost largest. Lateral spine formula 9-10:5-8:30-35, spines successively smaller posteriorly. Median postrostral carina defined, irregularly spinulose, bearing half way to cervical groove pair of stouter spines. Posterior margin of cervical groove spinulose. Postorbital carina obsolescent. Branchial carina obsolescent, sinuous, minutely spinulose. Posterior margin of carapace smooth.

Abdominal tergites 1-5 medially carinate, carinae blunt, lacking antrorse spine, sixth tergite noncarinate, smooth. Tergites 2-5 bearing transversely oblique submedian grooves. Pleura smooth. Second pleuron ovate. Telson with blunt median crest anteriorly, two smooth carinae posteriorly.

Merus of P1 basally dilated, with granulate margins and subterminal claw-like spine on upper margin; carpus nearly 2/3 as long as merus with subterminal spines on upper and lower margins; upper margin of propodus minutely serrulate, with subterminal spine. P5 subchelate in male, chelate in female.

Source : MNHN, Paris

REMARKS. — *P. snyderi* was summarily described by RATHBUN (1906) from a single specimen from Hawaii. *P. snyderi* is distinguished from *P. validus* by its subrectangular, spinose carapace and pectinate external orbital margin.

DISTRIBUTION. — Bay of Biscay, Indian Ocean Ridge, Hawaii. Known reliably between 1100-2245 m, collected too in a trawl between 573-1463 m.

Pentacheles validus A. Milne Edwards, 1880

Fig. 10

Pentacheles validus A. Milne Edwards, 1880: 65. — YOUNG, 1900: 443.
Polycheles validus - MOCQUARD, 1883: 153. — FAXON, 1895: 124. — BOUVIER, 1905a: 480; 1917: 45; 1925: 434, fig. 10, pl. 5. figs 1-2. — DE MAN, 1916: 6 (list). — BERNARD, 1953: 86. — SIVERTSEN & HOLTHUIS, 1956: 41. — DOLLFUS, 1956: 135. — FIRTH & PEQUEGNAT, 1971: 61. — PEQUEGNAT *et al.*, 1971: 4. — BEAUBRUN, 1979: 38. — WENNER, 1979: 443. — WENNER & BOESCH, 1979: 111. — RODRIGUEZ, 1980: 194 (list). — POHLE, 1985: 21. — DE SAINT LAURENT, 1985: 475. — DAWSON, 1997: 16.
Pentacheles debilis Smith, 1884: 360; 1886a: 188 (list); 1886b: 607, pl. 7, fig. 2. — VERRILL, 1885: 554 (list).
Pentacheles laevis BATE, 1888: 144, pl. 15, fig. 5 (p.p.). — MURRAY, 1986: 388.
Polycheles debilis – BOUVIER, 1905a: 480; 1905c: 3. — DE MAN, 1916: 5 (list). — FAXON, 1895: 124.
Polycheles debilis var. *armatus* Bouvier, 1905c: 4. — DE MAN, 1916: 5 (list).
Polycheles beaumontii (?) - STEBBING, 1908: 25; 1910: 377.
Pentacheles debilis - FOWLER, 1912: 570 [erroneous spelling].
Polycheles - MURRAY & HJORT, 1912: 420 [*fide* SIVERTSEN & HOLTHUIS, 1956].
Polycheles laevis - DE MAN, 1916 (list) (p.p.).
Polycheles demani Stebbing, 1917: 28, pl. xcii. — CALMAN, 1925: 17. — BARNARD, 1950: 570, figs 105a-c. — KENSLEY, 1968: 292; 1974: 69; 1981b: 29. — FIRTH & PEQUEGNAT, 1971: 45.
Polycheles chilensis Sund, 1920: 226. — HOLTHUIS, 1952a: 78. — BERNARD, 1953: 86. — BAHAMONDE, 1963: 4. — ZARENKOV, 1969: 81. — FIRTH & PEQUEGNAT, 1971: 42. — RETAMAL, 1981: 15. — WICKSTEN, 1989: 304. — DAWSON, 1997: 8.

MATERIAL EXAMINED. — **Bay of Biscay**. BIOGAS IV, CP 01: 47°34.6'N, 8°36.8'W, 25.02.1974, 2245 m, coll. IFREMER: 1 ♀ 44.4 mm; 1 ♂ damaged (MNHN-Pa 563).

Canary Is. *"Talisman"*: stn 39, 30°08'N, 14°02'W, 2300 m, 23.06.1883: 1 juv. (MNHN-Pa 15). — Stn 41, 30°01'N, 14°06'W, 2115 m, 24.06.1883: 2 juvs (MNHN-Pa 16). — Stn 43, 29°52'N, 14°04'W, 2075 m, 25.06.1883: 2 juvs (MNHN-Pa 14).

CANCAP 2: stn 26, 27°50'N, 14°29'W, 1980-2200 m, 25.08.1977: 8 ♀ 20.0-49.7 mm (RMNH).

Azores. CANCAP 5: stn 5.004, 38°06'N, 25°49'W, 2400-3100 m, 24.05.1981: 6 juvs (RMNH). — Stn 5.052, 36°42'N, 25°09'W, 2500-3000 m, 30.05.1981: 1 ♂ 42.6 mm (RMNH). — Stn 5.171, 39°20'N, 30°52'W, 1874-1887 m, 11.06.1981: 1 juv. (RMNH).

West Africa. *Ivory Coast. "Pillsbury"*: stn 314, 4°58'N, 3°48'E, 2268-2332 m, 27.05.1965: 1 ♂ 69.3 mm; 1 ♀ 69.3 mm (RMNH).

South Africa. *Cape Point Lighthouse*: NE 40 mi., 1024-1280 m, coll. Dr. GILCHRIST: 1 ♀ 66.9 mm (NHM 1928.12.1.337). — NE 43 mi., 1620 m, 1 ♂ 61.1 mm (SAM A4343).

South Atlantic. South Georgia I., 53°26.7'S, 36°32.6'W, 1967-2186 m, 17.05.1975: 1 juv. (USNM).

Bahama Is. (F.M. BAYER). N of Andros I., 1737 m, 5.03.1973: 1 juv. (USNM 154324). — N of Andros I., 24°24.48'N, 76°11.24'W, 1757 m, 13.02.1974: 3 juvs (USNM 154326). — Exuma Sound, 24°39'N, 76°26.54'W, 1624 m, 12.04.1975: 2 ♂ 49.3, 50.6 mm; 1 ♀ 22.9 mm (USNM 154399). — 24°31.54'N, 76°17.12'W, 1673 m, 12.04.1975: 1 ♂ 53.7 mm; 1 ♀ 23.5 mm (USNM 154398). — 24°38.54'N, 76°26.15'W, 1628 m, 15.04.1975: 1 ♀ 28.5 mm (USNM 154328). — 23°55'N, 75°27.12'W, 2178 m, 16.04.1975: 1 ♀ 33.8 mm (USNM 154329).

"Iselin": stn 73, 24°46'N, 75°41'W, 1792 m, 4.03.1972: 1 ♀ (RMNH 31659). — Stn 346, 22°55'N, 75°17.06'W, 2426 m, 17.04.1975: 1 ♀ 37.1 mm (USNM 154331). — Stn 8007, 22°46'N, 75°34'W, 7.09.1980: 1 ♂ 57.6 mm (USNM 344508).

United States. *East Coast. "Albatross"*: stn 2074, 41°43'N, 65°21'50"W, 2393 m, 3.09.1883: 1 ♂ 20.0 mm (USNM 7145).

Caribbean Sea. Jamaica. *"Albatross"*: stn 2140, 17°36'10"N, 76°46'05"W, 1768 m, 11.03.1884, id. M.J. RATHBUN as *P. debilis*: 1 juv. (USNM 23751).

"Oregon": stn 2571, 26°34'N, 90°31'W, 2340 m, 27.07.1959: 1 ♂ 50.7 mm (USNM 232276). — Stn 2574, 26°34'N, 89°53'W, 2610 m, 28.07.1959: 1 ♂ 32.2 mm; 1 ♀ 77.0 mm (USNM 232276). — Stn 2575, 27°06'N, 89°13'W, 1980-

Source : MNHN, Paris

2160 m, 29.07.1959: 1 ♂ 31.4 mm (USNM 232276). — Stn 2814, 28°53'N, 87°47'W, 1710-1890 m, 13.07.1960: 1 ♂ 51.7 mm (USNM 232276).

"Pillsbury": stn 634, 23°33'N, 82°47'W, 1638-1757 m, 25.03.1968: 1 ♂ 35.8 (RMNH). — Stn 1178, 19°14'N, 73°14'W, 1750 m, 30.06.1970: 1 ♂ 62.2 mm (RMNH).

Gulf of Mexico. *"Albatross"*: stn 2379, 28°00'15"N, 87°42'W, 2684 m, 2.03.1885: 1 ♀ 27.3 mm (USNM 23645). — Stn 2383, 28°32'N, 88°05'W, 2161 m, 3.03.1885, id. M.J. RATHBUN as *P. debilis*: 1 juv. (USNM 23752).

"Oregon": stn 2577, 27°48'N, 88°45'W, 1530-1980 m, 30.07.1959: 1 ♂ 48.1 mm (USNM 232276). — Stn 2819, 28°35'N, 88°16.5'W, 1620-1800 m, 15.07.1960: 1 ov. ♀ 56.8 mm (USNM 232276). — Stn 2820, 28°23'N, 88°21.5'W, 1800 m, 15.07.1960: 1 ♂ 46.0 mm (USNM 232276).

"Oregon II": stn 10878, 28°54'N, 87°29'W, 1830 m, 16.01.1970, id. B. ANDRYZAK as *P. demani*: 1 ♂ 55.2 mm (USNM 283665). — Stn 10881, 24°51'N, 96°00'W, 1669 m, 24.01.1970, id. B. ANDRYZAK as *P. demani*: 4 ♂ 39.9-49.6 mm; 1 ♀ 63.2 mm (USNM 283667). — Stn 10897, 28°45'N, 88°23'W, 1647 m, 28.01.1970: 1 ♂ 42.2 mm (USNM 283669).

Chile. *"Challenger"*: stn 300, Juan Fernandez Is, 33°42'S, 78°18'W, 2516 m, 17.12.1875: 1 ♀ 20.0 mm (NHM 1888.22).

"Albatross": stn 2788, 45°35'S, 75°55'W, 1921 m, 11.02.1888: 3 ♂ 19.3-41.1 mm; 2 ov. ♀ 59.6, 66.9 mm (USNM).

Wallis & Futuna Is area. MUSORSTOM 7. *SW of Combe Bank*: stn 621, 12°35.0'S, 178°11.5'W, 1300-1280 m, 28.05.1992: 1 ♀ 26.8 mm (MNHM-Pa 1734). — Stn 623, 12°34'S, 178°15'W, 1280-1300 m, 28.05.1992: 1 juv. (MNHM-Pa 1735).

Vanuatu. MUSORSTOM: 8: stn CP 1111, 14°51.09'S, 167°14'E, 1210-1250 m, 8.10.1994: 1 ♂ 31.6 mm (MNHN-Pa 1674).

New Caledonia. BIOCAL: stn CP 60, 24°01'S, 167°08'E, 1480-1530 m, 2.09.1985: 1 juv. (MNHN-Pa 1736).

HALIPRO 2: stn BT 22, 24°09'S, 167°47'E, 1349-1350 m, 21.11.1996: 1 ov. ♀ 58.4 mm (MNHN). — Stn BT 95, 24°00'S, 162°08'E, 1224-1233 m, 25.11.1996: 1 damaged (MNHN-Pa 1705). — Stn BT 103, 24°54'S, 162°09'E, 1235-1256 m, 26.11.1996: 1 ♂ 53.2 mm (MNHN-Pa 1706). — Stn BT 105, 24°45'S, 162°50'E, 1200-1218 m, 27.11.1996: 1 ♂ 56.7 mm; 1 ♀ 61.9 mm (MNHN-Pa 1707).

New Zealand. NZOI: stn P971, 41°11.9'S, 177°19.6'E, 2200-2328 m, 18.06.1980: 1 ♂ 39.5 mm (NIWA). — Stn P941, 41°15.2'S, 167°07.2'E, 1463-1457 m, 23.04.1980: 1 ♀ 37.4 mm; 1 juv. (NIWA). — Stn X188, 36°46.30'S, 177°15.06'E, 1500 m, 4.12.1989: 1 ♀ damaged (NIWA). — Stn U198, 35°59.3'S, 162°11.21'E, 1573 m, 26.09.1982: 1 juv. (NIWA). — Stn Z8391, 44°21.72'S, 177°52.90'E, 1143-1145 m, 10.10.1995: 1 ♀ 48.9 mm (NIWA).

Australia. *Tasmania*. 34°28'S, 132°03'E, 1175 m, 11.01.1984: 1 ov. ♀ 75.1 mm (TM G3279). — 41°53.6'S, 144°24.6'E, 1384-1416 m, 18.05.1986: 1 ♀ 45.8 mm (TM G3482). — 42°22.4'S, 144°37.9'E, 1376-1404 m, 8.01.1988: 1 ♂ 39.9 mm; 1 ♀ 39.2 mm (TM G3978).

Australian Bight. *"Galathea"*: stn 554, 37°28'S, 138°55'E, 1350 m, 12.05.1951: 1 ♂ 38.5 mm (ZMC).

Indian Ocean. **East Indian Ridge**, *"Prof. Mesyatsev"*: 31°55'S, 87°54'E, 1645-1600 m, 30.03.1979, coll. M. KARPINSKI: 1 ♀ 49.1 mm (ZMMU).

TYPES. — The large female (82 mm cl) (MCZ 4041) collected by the *"Blake"* stn 236, off Bequia (Antilles, Windward Islands), 2909 m (BOUVIER, 1925: 437), is the holotype of *Pentacheles validus* A. Milne Edwards, 1880.

The male (20.0 mm cl) (USNM 7145) collected by the *"Albatross"* stn 2074, off New England (41°43'N, 65°21'50"W, 2393 m), is designated here as the lectotype of *Pentacheles debilis* Smith, 1884; the male (19.5 mm cl) (USNM 7146) collected at stn 2084 (40°16.50'N, 67°05.15'W, 2359m) is the paralectotype.

The female (20 mm cl) (NHM 1888.22) collected by the *"Challenger"* stn 300, off Juan Fernandez I.(33°42'S, 78°18'W, 2516 m), is the holotype of *Polycheles chilensis* Sund, 1920.

The female (66.9 mm cl) (NHM 1928.12.1.337) collected off Cape Point Lighthouse, 1024-1280 m, South Africa, is the holotype of *Polycheles demani* Stebbing, 1917.

The juvenile collected by the *"Talisman"* stn 39, (MNHN-Pa 15) off the Canaries (30°08'N, 14°02'W, 2300 m), is designated here as the lectotype of *Polycheles armatus* Bouvier, 1905; the specimens from stns 41 (MNHN-Pa 16) (30°01'N, 14°06'W, 2115 m) and 43 (MNHN-Pa 14) (29°52'N, 14°04'W, 2075 m) are paralectotypes.

DESCRIPTION. — Carapace ovate. Dorsal surface of carapace setose, minutely granulose. Anterior margin concave, rostrum bifid, antrorse. Internal and external angles of orbital sinus irregularly spinose (0-2), sometime differing between left and right sides. Eyestalk bearing upcurved spine. Basal antennular segment lamellar, produced anteriorly to a sharp point, prominently spinose along its mesial edge, single spine on antero-external angle. Spine formula of lateral margins of carapace 7-9:4:20-32, spines posterior to postcervical incision successively decreasing

Source : MNHN, Paris

in size. Median postrostral carina with antrorse spinules, pair of larger spines 2/3 way to cervical groove; median postcervical carina with two files of antrorse tubercles, pair of larger spines one third distance to posterior margin. Gastro-orbital region bearing two (sometimes three) prominent spines anteriorly, some six spinules posteriorly. Posterior margin of cervical groove spinose. Branchial carina obsolescent. Carapace between median postcervical and branchial carinae with conical tubercles, between branchial carina and lateral margin minutely granulate. Posterior margin of carapace smooth.

Abdominal tergites 1-5 bearing blunt median carina, 1-3 armed anteriorly with obtuse tooth, sixth tergite noncarinate. Tergites 2-5 with deep, transversely oblique, submedian grooves. Pleura smooth. Telson with triangulate basal tubercule, smooth submedian carinae convergent posteriorly.

Subterminal claw-like spine on upper margin of merus and propodus of P1. Carpus, 3/4 as long as merus, with small subterminal spine on lower margin. P5 subchelate in male, chelate in female.

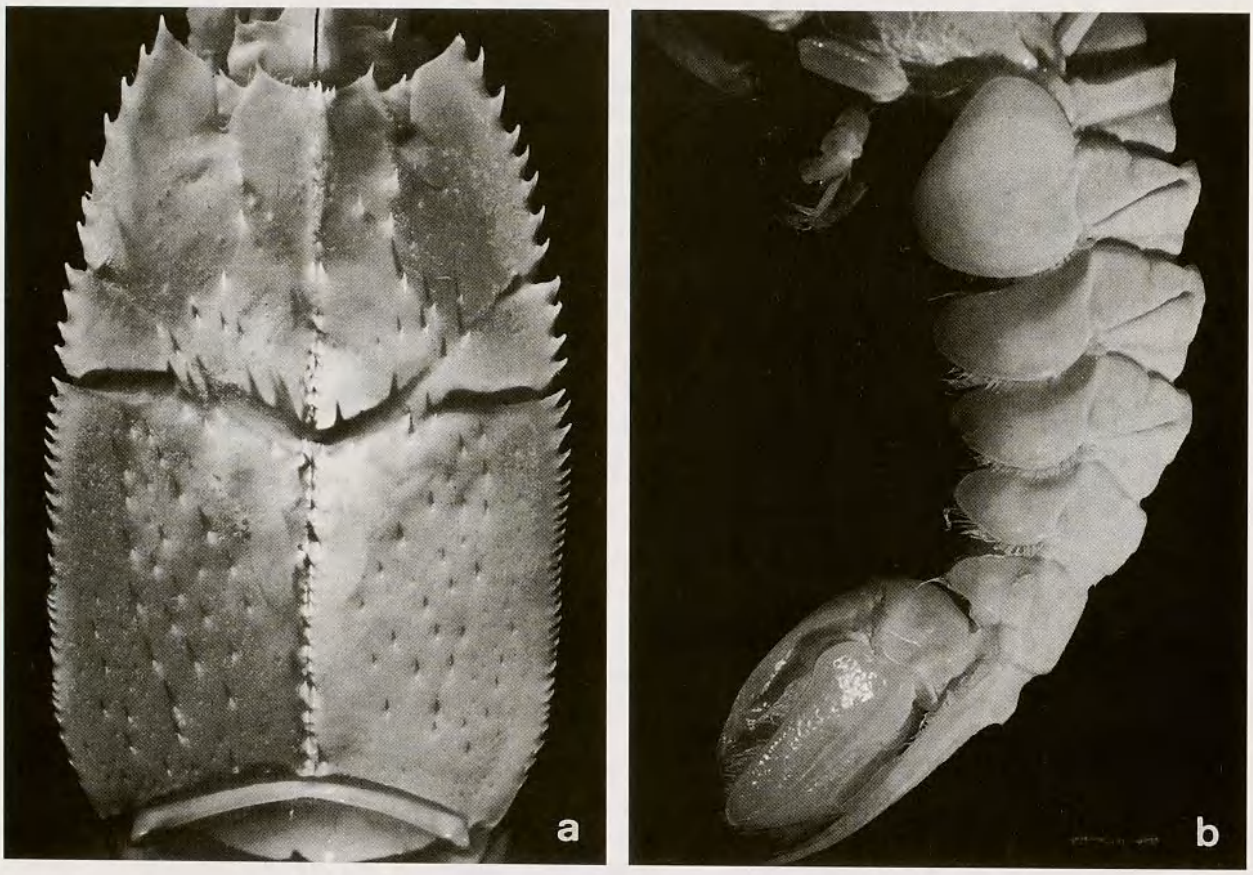

FIG. 10. — *Pentacheles validus* A. Milne Edwards, 1880, ♂ 49.3 mm, Bahama Is, 24°39'N, 76°26.54'W, 1624 m (USNM 154399): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

REMARKS. — A. MILNE EDWARDS (1880: 65) described *P. validus* as having "Les cinq premiers articles de l'abdomen portent en dessus une carène obtuse terminée en avant par une pointe mousse; de cette pointe part de chaque côté un sillon profond dirigé en arrière et en dehors". Similarly, SMITH (1884: 361) described his two immature males of *P. debilis*: "The first five somites of the pleon are perceptibly, though very inconspicuously, carinated, and on the second, third, and fourth somites there is a narrow sulcus each side, extending from near the carina outward and backward", and readily admitted "it is probably most nearly allied to *P. validus* A. M. Edwards". BOUVIER (1905c: 4), whose type series consisted of juvenile specimens only, distinguished the east Atlantic var. *armatus* from *P. debilis* by its "armature spiniforme sur le bord externe du sinus orbitaire", an unstable character. By 1917, BOUVIER himself synonymized both *debilis* and var. *armatus* with *P. validus*, and in 1925 (: 4)

Source : MNHN, Paris

wrote: "Les spécimens recueillis par le Talisman et la Princesse Alice m'ont permis d'établir, avec une entière certitude, que les exemplaires capturés par l'Albatross et décrits sous le nom de *P. debilis* Smith ne sont rien autre chose que des *P. validus* de médiocre ou de petite taille". Examination of the single juvenile specimen from *"Challenger"* stn 300, assigned to *laevis* by BATE (1888: 145) and then to *P. chilensis* by SUND (1920: 226), revealed it to be *P. validus*.

DISTRIBUTION. — Worldwide: Bay of Biscay, Canary Is, Azores, West Africa, South Africa., S. Georgia I., Mid Atlantic Bight, United States, Bahama Is, Caribbean Sea, Gulf of Mexico, Chile, Vanuatu, Wallis & Futuna Is, New Caledonia, New Zealand, Tasmania, Australian Bight, East Indian Ridge; 914 m (present work) - 3365 m (FIRTH & PEQUEGNAT, 1971).

POLYCHELES Heller, 1862

Polycheles Heller, 1862: 389; 1863: 209. Gender masculine.
Type species, by monotypy, *Polycheles typhlops* Heller, 1862: 392.
Name placed on the official list of Generic Names in Zoology (p. 153) in Opinion 519 of the International Commission on Zoological Nomenclature.
Eryoneicus Bate, 1882: 456. Gender masculine.
Type species, by monotypy, *Eryoneicus caecus* Bate, 1882: 457.
Name suppressed by the International Commission on Zoological Nomenclature in Opinion 702 (1964, Bulletin of Zoological Nomenclature, 21(2):111, 112).
Stereomastis Bate, 1888: 154. Gender feminine.
Type species, designated by HOLTHUIS, 1962 (Bull. Zool. Nomencl., (19): 183): *Pentacheles suhmi* Bate, 1878: 278.
Name validated under the plenary powers in Opinion 702 of the ICZN and placed on the Official List of Generic Names in Zoology (p. 112).

DIAGNOSIS. — Carapace dorsoventrally flattened, subrectangular. Anterolateral angle of carapace produced, spiniform. Lateral margins well defined, spinose; cervical and postcervical incisions dividing margin into three parts. One or two rostral spines. Orbital sinus simple or compound, eyestalk filling orbit, continuing distad, beneath anterolateral angle of carapace.

Cervical groove marked, arcuate, laterally bifurcate. Postrostral and postcervical carinae well defined, granulate, spinulate. Gastro-orbital, posterior branchial carinae well defined. Sublateral carina starting near posterolateral margin of carapace, running to base of antenna and first cheliped.

Abdomen laterally depressed. First abdominal tergite narrow; pleura fused, abbreviated. Abdominal tergites 2-5 sculptured, medially carinate; sixth tergite medially bicarinate. Second abdominal pleuron clypeiform; pleura 3-5 lingulate, successively diminishing in size posteriorly. Abdominal sternites with median knob. Telson lanceolate, with median basal tubercle, two submedian carinae. Uropodal exopod lamellar, rounded; endopod oar-shaped, basal lappet on interior margin.

Mesial margin of basal antennular segment anteriorly produced, upcurved, reaching beyond peduncle; basal antennular segment proximally rounded, its anterolateral angle uni- or bispinose. Outer antennular flagellum short, inner flagellum as long as antennal flagellum. Renal process well developed, tubular, fitting into hollow on underside of basal antennular segment. Antennal scaphocerite lanceolate, extending to base of flagellum.

Buccal opening subquadrate. Mandible concave, cutting edge with triangular teeth of uneven size; mandibular palp biarticulate. Maxillula with two incurved lobes, distally setose. Maxilla with two slender lobes, internal lobe half as long as lateral; large scaphognathite. First maxilliped endopod slender; exopodal lobe membraneous, reniform, extending further back than scaphognathite; exopod anteriorly divided into two lobes enclosing efferent passage. Second and third maxillipeds, slender, pediform; epipod on basal segment of third maxilliped rudimentary; dactyl as long as preceding segment.

Pereiopods 1-4 chelate, P5 simple or subchelate in male, chelate in female. P1 longer, more robust than P2-5; pereiopods successively shorter posteriorly. Fingers of first and second chelipeds crossing, their inner margin furnished with row of overlapping cornute platelets, forming serrate edge. Fingers of chelae of P3-4 slightly

Source : MNHN, Paris

upcurved, their inner margins simple. First male pleopod spatuliform, spinulose, swelling distally on inner margin; spinules distally on mesial margin; distal margin folded internally. Pleopods 2-6 biramose, with rod-like appendix interna; second pair in male with appendix masculina.

REMARKS. — "There seems to be some little doubt as to the right nomenclature of the various species of this group" - an understated comment by ALCOCK (1901b: 165) that fails to convey the nomenclatural confusion in the genus.

HELLER (1862), described the fifth pereiopodal dactyl of the single male specimen of *Polycheles typhlops* as simple. With the rush of excitement engendered by the findings of the *"Challenger"*, an error was introduced when BATE (1878a: 276) described *Pentacheles* as differing from *Polycheles* "in having the last pair of pereiopods always more or less perfectly chelate". NORMAN (1878: 382) intuited "Has not my friend mistaken sexual for generic characters?" but was brusquely rebuffed, though BATE (1878b: 484) admitted "I was hesitating where several species of *Pentacheles* should be placed, as there is a regular gradation from the imperfect to the perfect chelate character of the fifth pereiopod; but as I found *Polycheles*, both male and female, with simple non-chelate foot, at present it appears to me that there is no arrangement so constant as that which I propose." This last statement was patently false - BATE examined both male and female specimens of *Polycheles baccatus*, which fifth pereiopod is simple in male, chelate in female and *P. helleri*, which fifth pereiopod is subchelate in male, chelate in female. FAXON (1895: 118) recognized that chelation of the fifth pereiopod in this genus was both sex and age-dependent and was gravely critical of BATE: "That author was most arbitrary in the disposal of his own species".

A decade later, BATE (1888: 154) erected *Stereomastis*: "This genus differs in nothing externally from *Pentacheles*, but is established to receive those species in which the mastigobranchial lash does not exist".

ALCOCK (1901b: 165) acknowledged the value of the third maxilliped epipod, recognizing *Polycheles* (rather than *Stereomastis*) as having "epipodite of the external maxillipeds .. a mere papilla". Adding to the confusion, ALCOCK kept shifting species from one genus to the other: *phosphorus* was placed first in *Pentacheles* (ALCOCK & ANDERSON, 1894: 165), then in *Polycheles* (1901b: 168); *hextii*, placed in *Pentacheles* (1901b: 171), was found to be synonymous with *Polycheles typhlops*.

No wonder then that BALSS (1925: 16) wrote in consternation: "Alle Unterschiede generischer Art, die man zwischen einzelnen Formen hat finden wollen, sind, wie sich herausgestelt hat, so geringfûgiger Natur und zudem noch durch Übergange verbunden, das man am besten alle zu den obigen drei Gattungen gerechneten Arten unter dem âltesen Namen *Polycheles* zusammenfast".

Eryoneicus Bate 1882, early presumed "a young and immature form of some species allied to *Polycheles*" (BATE, 1888: 125). Yet, although "In all essential characteristics" resembling *Polycheles* (ALCOCK, 1901b: 176), it was considered a separate genus. FAXON (1895: 108), on examining the eight specimens collected by the "*Albatross*" wrote "The existence of well developed external sexual organs... at once disposes of the theory that *Eryonicus* is an immature stage in the development of some other genus". SUND (1915: 372) believed the close correspondence in carapace spine formula "evidence of the *Eryonicus* species being in fact larval *Polycheles*". GORDON (1960) recognized 37 "species" of *Eryoneicus*, many unrelated to adult polychelids. Following the ruling of the ICZN to suppress *Eryoneicus* (ICZN 702), it is used to denote polychelid larval stages, though DE SAINT LAURENT (1979) maintains that they are adults secondarily adapted to life in the bathypelagial.

Polycheles differs from the other polychelid genera in having only a rudimentary epipod on the basal segment of the third maxilliped. It is distinguished from *Willemoesia* and *Cardus* in having the fifth pereiopodal dactyl simple or subchelate in the male, chelate in the female, and from *Pentacheles* and *Homeryon* in having the basal antennular segment proximally rounded.

Polycheles aculeatus sp. nov.

Fig. 11

Stereomastis phosphorus - GRIFFIN & STODDART, 1995: 246, figs 9-11 (p.p.).

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn CC 992, 18°52.34'S, 168°55.16'W, 775-748 m, 24.09.1994: 1 juv. (MNHN-Pa 1425). — Stn CC 994, 18°47.72'S, 168°17'W, 649-641 m, 24.09.1994: 4 ♂ 20.6-44.6 mm

Source : MNHN, Paris

(MNHN-Pa 1426). — Stn CC 996, 18°52.41'S, 168°55.73'W, 764-786 m, 24.09.1994: 2 ♂ 33.2, 34.4 mm; 1 ♀ 34.7 mm (MNHN-Pa 1427). — Stn CC 1033, 17°54.75'S, 168°40.66'W, 650-691 m, 29.09.1994: 3 ♀ 23.0-47.7 mm (MNHN-Pa 1428). — Stn CC 1056, 16°33.11'S, 167°55.64'W, 602-620 m, 1.10.1994: 2 ♂ 46.6, 53.9 mm; 2 ♀ 52.5, 57.7 mm (MNHN-Pa 1429). — Stn CC 1073, 15°45.70'S, 167°22.24'W, 630-650 m, 4.10.1994: 2 ♂ 33.1, 42.5 mm; 1 ♀ 48.9 mm; 1 juv. (MNHN-Pa 1430). — Stn CC 1124, 15°01.72'S, 166°56.51'W, 532-599 m, 9.10.1994: 1 ♀ 49.2 mm; 2 juvs (MNHN-Pa 1431).

Loyalty Islands. MUSORSTOM 6: stn DW 426, 20°24.60'S, 166°22.90'E, 610 m, 17.02.1989: 1 ♂ 22.5 mm (MNHN-Pa 1434).

New Caledonia. BATHUS 1: stn CP 663, 20°58.66'S, 165°38.27'E, 730-780 m, 13.03.1993: 2 ♀ 28.3, 51.5 mm (MNHN-Pa 1435). — Stn CP 702, 20°55.97'S, 165°34.67'E, 591-660 m, 18.03.1993: 1 ♀ 69.8 mm (MNHN-Pa 1436).

BATHUS 2: stn CP 741, 22°35.53'S, 166°26.56'E, 700-950 m, 14.05.1993: 2 ♂ 48.3, 49.1 mm; 2 ♀ 45.5, 57.0 mm, 2 juvs (MNHN-Pa 1437). — Stn CP 743, 22°35.6'S, 166°26.2'E, 713-950 m, 14.05.1993: 3 ♂ 23.7-28.6 mm; 1 ♀ 40.6 mm, 1 juv. (MNHN-Pa 1438). — Stn CP 751, 22°24'S, 166°12'E, 1300-1500 m, 15.05.1993: 1 ♂ 42.4 mm; 1 ♀ 46.3 mm, (MNHN-Pa 1604). — Stn DW 753, 22°35.6'S, 166°26.2'E, 144-155 m, 15.05.1993: 1 ♂ 45.6 mm (MNHN-Pa 1423). — Stn CP 765, 22°09.6'S, 166°02.8'E, 600-630 m, 17.05.1993: 1 ♂ 43.0 mm; 2 ♀ 28.4, 61.8 mm (MNHN-Pa 1439). — Stn CP 766, 22°10'S, 166°01.7'E, 650-724 m, 17.05.1993: 3 ♂ 25.9-32.6 mm; 3 ♀ 24.7-33.8 mm, 1 juv. (MNHN-Pa 1440). — Stn CP 771, 22°09.52'S, 166°01.75'E, 610-800 m, 18.05.1993: 2 ♂ 24.7, 48.3 mm; 1 ♀ 60.9 mm; 1 juv. (MNHN-Pa 1441).

BATHUS 4: stn CP 899, 20°16.68'S, 163°50.26'E, 500-600 m, 3.08.1994: 1 ♀ 19.4 mm (MNHN-Pa 1442). — Stn CP 910, 18°59.32'S, 163°08.47'E, 560-608 m, 5.08.1994: 1 ♀ 20.3 mm (MNHN-Pa 1443). — Stn CP 912, 18°55.61'S, 163°07.68'E, 702-690 m, 5.08.1994: 1 ♀ 19.9 mm (MNHN-Pa 1444). — Stn CP 948, 20°33.13'S, 164°57.03'E, 533-610 m, 10.08.1994: 1 ♀ 52.2 mm (MNHN-Pa 1445). — Stn CP 949, 20°32.01'S, 164°56.85'E, 616-690 m, 10.08.1994: 1 ♂ 42.9 mm (MNHN-Pa 1446). — Stn CP 950, 20°31.93'S, 164°56.11'E, 705-750 m, 10.08.1994: 3 ♂ 29.7-46.7 mm; 1 ♀ 54.9 mm (MNHN-Pa 1468).

HALIPRO 1: stn CP 854, 21°45.77'S, 166°38.34'E, 650-780 m, 19.03.1994: 1 juv. (MNHN).

Chesterfield Islands. MUSORSTOM 5: stn 324, 21°15.01'S, 157°51.33'E, 970 m, 14.10.1986: 3 juvs (MNHN-Pa 1432). — Stn CC 384, 19°42.40'S, 158°50.80'E, 21.10.1986: 1 juv. (MNHN-Pa 1433).

Indonesia. *"Siboga":* stn 297, Timor Sea, 10°39'S, 123°40'E, 520 m, 27.01.1900: 1 ♀ 27.7 m (ZMA).

Off south coast of Bali, 08°34'S, 115°36'E, 27.06.1981: 1 ♀ 62.0 mm (USNM 356448).

KARUBAR. *Tanimbar I.* : stn CC 39, 7°47'S, 132°26'E, 477-466 m, 28.10.1991: 2 ♂ 39.7, 45.8 mm; 5 ♀ 43.3-58.7 mm (MNHN-Pa 1447). — Stn CC 40, 7°46'S, 132°31'E, 443-468 m, 28.10.1991: 2 ♂ 38.7, 50.5 mm; 4 ♀ 34.9-63.0 mm (MNHN-Pa 1448). — Stn CC 41, 7°45'S, 132°42'E, 401-393 m, 28.10.1991: 2 ♂ 39.7, 45.8 mm; 5 ♀ 43.3-58.7 mm (MNHN-Pa 1449). — Stn CC 42, 7°53'S, 132°42'E, 354-350 m, 28.10.1991: 1 ♀ 56.5 mm (MNHN-Pa 1450). — Stn CC 56, 8°16'S, 131°59'E, 552-549 m, 31.10.1991: 2 ♀ 43.5, 44.0 mm (MNHN-Pa 1451). — Stn CP 69, 8°42'S, 131°53'E, 358-368 m, 2.11.1991: 3 ♂ 25.1-35.1 mm; 2 ♀ 44.8-64.0 mm (MNHN-Pa 1452). — Stn CP 72, 8°36'S, 131°33'E, 699-676 m, 2.11.1991: 1 ♀ 58.3 mm (MNHN-Pa 1453). — Stn CP 76, 8°50'S, 131°33'E, 401-400 m, 3.11.1991: 2 ♂ 31.3, 36.4 mm; 4 juvs (MNHN-Pa 1455). — Stn CP 78, 9°06'S, 132°4'E, 295-284 m, 3.11.1991: 5 ♂ 18.0-28.0 mm; 4 ♀ 19.4-26.6 mm (MNHN-Pa 1456).

Kai I.: stn CP 9, 5°23'S, 132°29'E, 368-389 m, 23.10.1991: 4 ♂ 26.6-46.8 mm (MNHN-Pa 1457). — Stn CC 10, 5°21'S, 132°30'E, 329-389 m, 23.10.1991: 5 ♂ 36.6-48.6 mm; 4 ♀ 27.6-62.2 mm (MNHN-Pa 1458). — Stn CP 12, 5°23'S, 132°37'E, 436-413 m, 23.10.1991: 1 ♂ 42.2 mm; 1 ♀ 47.5 mm (MNHN-Pa 1459). — Stn CP 35, 6°08'S, 132°45'E, 390-502 m, 27.10.1991: 4 ♂ 27.9- 43.4 mm; 1 ♀ 37.0 mm (MNHN-Pa 1460).

East China Sea. *"Ryoan Maru"*: 29°44'N, 127°48'E, 495-510 m, 19.03.1978, id. Y. MIYA as *Stereomastis andamanensis*: 1 ♀ 57.3 mm (NUM Cr10239).

Australia. *North West Coast.* N.N.W. of Cape Leveque, *"Solea"*: 13°07.2'S, 123°15.7'E, 400 m, 15.02.1984: 1 ov. ♀ 60.3 mm (WAM C23588). —N.W. Collier Bay, *"Solea"*: 13°44'S, 122°13.3'E, 496-494 m, 13.02.1984: 1 ov. ♀ 51.2 mm (WAM C23515). —N.W. York Sound, *"Solea"*: 12°48.1'S, 122°56.7'E, 496-504 m, 15.02.1984: 1 ♂ 48.1 mm (WAM C23514). —N.W. of Beagle Bay, *"Solea"*: 15°12.8'S, 121°05.9'E, 410-404 m, 11.02.1984: 2 ♂ 38.9, 38.7 mm; 1 ov. ♀ 54.9 mm (WAM C23587). — W. of Lacepede Arch., *"Solea"*: 16°55.2'S, 119°52.8'E, 432-430 m, 20.02.1984: 2 ♂ 52.4, 52.2 mm; 1 ♀ 56.2 mm (WAM C23526). —16°56.8'S, 119°51.0'E, 480-432 m, 20.02.1984: 2 ♂ 48.8, 45.7 mm (WAM C23525). —14°50.2'S, 121°31.4'E, 356 m, 12.02.1984: 1 ov. ♀ 64.4 mm (WAM C23517). —16°56'S, 119°53.0'E, 436 m, 22.02.1984: 1 ♀ 50.7 mm (WAM C23528). — Off Port Hedland, *"Solea"*: 16°46.1'S, 119°44'E, 495-502 m, 19.08.1983: 1 ♂ 58.5 mm; 1 ♂ juv. 31.7 mm (WAM C23596). —17°55'S, 118°22.0'E, 437-442 m, 21.08.1983: 1 ♀ 51.9 mm (WAM C23521). —*"Solea"*: 18°29.1'S, 117°42.5'E, 352-356 m, 18.08.1983: 1 ♂ 51.6 mm (TM G3777). — 18°34.1'S, 117°27.5'E, 400-402 m, 16.08.1983: 1 ♂ 48.8 mm (TM G3776). — Off Port Hedland, *"Solea"*: 17°42'S, 118°38'E, 402-404 m, 18.08.1983: 1 ♀ 53.7 mm (WAM C23519). — 17°42'S, 118°38'E, 402-404 m, 18.08.1983: 1 ♂ 44.1 mm (WAM C23520).

TYPES. — The holotype is the male (45.6 mm cl) (MNHN-Pa 1423) collected in New Caledonia, BATHUS 2 stn DW 753 (22°35.6'S, 166°26.2'E, 144-155 m). Two males and one female (MNHN-Pa 1427) collected in

Source : MNHN, Paris

Vanuatu, MUSORSTOM 8 stn CC 996 (18°52.41'S, 168°55.73'W, 764-786 m), an ovigerous female (WAM C23588) collected in Australia (NW coast), and a female (USNM 356448) collected in Indonesia off Bali, are paratypes.

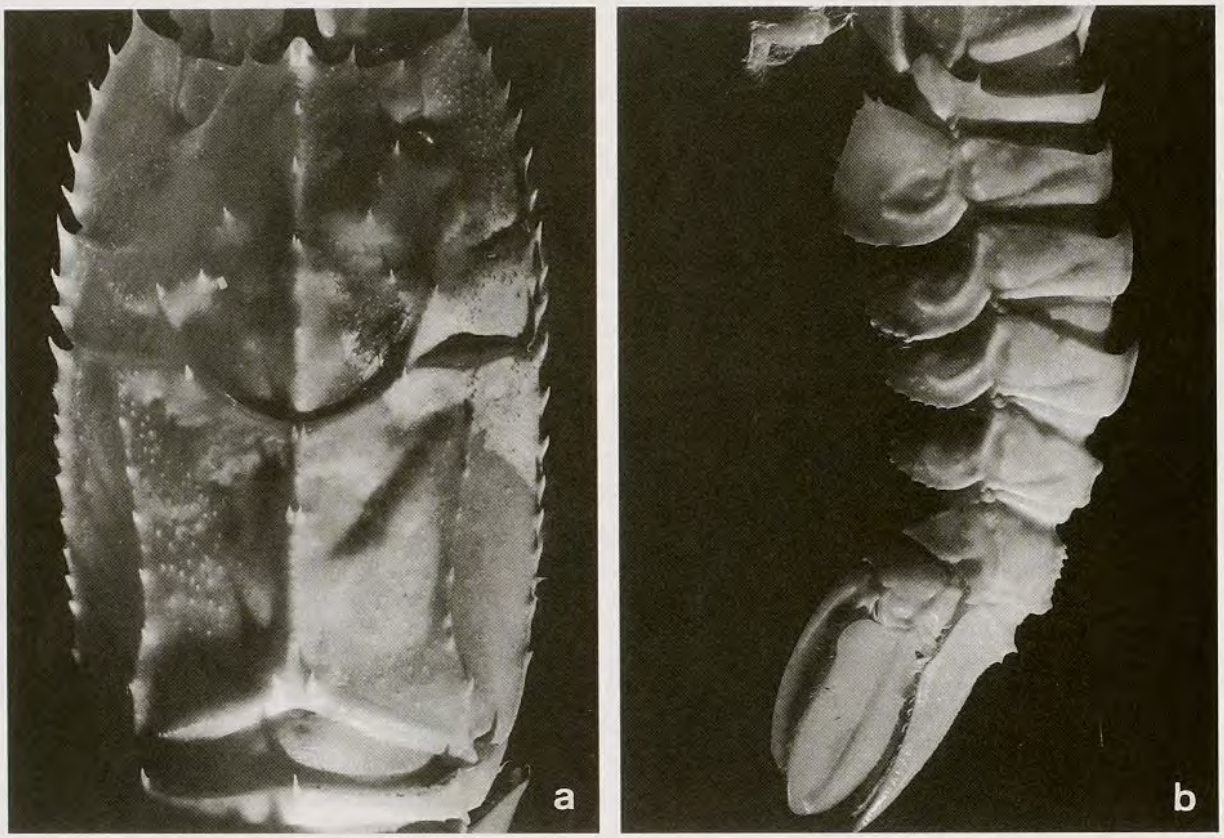

FIG. 11. — *Polycheles aculeatus* sp. nov., ♂ 42.8 mm, Vanuatu, MUSORSTOM 8, stn 994, 18°47.72'S, 168°17'W, 649-641 m (MNHN-Pa 1426): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

DESCRIPTION. — Lateral margins of carapace subparallel, slightly convergent anteriorly. Dorsal surface of carapace tomentose. Anterior margin of carapace straight. Median submarginal tooth prominent, upcurved, fronting small, bifid rostrum. Internal angle of orbital sinus bearing small spine, external angle unarmed. Eyestalk with mammilate tubercle, curved distad. Basal antennular segment produced anteriorly to a sharp point, mesial margin smooth; antero-external margin angled, bispinose, anterior spine longer than posterior. Spines on lateral margins of carapace decreasing successively in size posteriorly; spine formula 6-7:3:8-10. Spine formula of median postrostral carina 1:1:2:1; postcervical carina with two pairs of spines. Posterior margin of cervical groove with antrorse spine midway between median and branchial carinae. Gastro-orbital region bearing five spines in curved row, anterior and posterior spines largest. Branchial carina sinuous, bearing 6 or 7 spinules, posteriormost largest. Posterior margin of carapace bearing two prominent, antrorse submedian spines. Anterior margin of first tergite with two pairs of lateral spines.

Abdominal tergites medially carinate; carinae 1-4 with antrorse spines; third and fourth prominent, salient; fifth carina bicuspid; sixth bearing denticulate double carina, confluent posteriorly in somewhat larger tooth. Tergites 2-5 with oblique submedian grooves obsolescent. Pleura 2-5 with curved rib mesially, margins denticulate. Second pleuron anteriorly produced, triangulate, prominently spinose. Telson with short, denticulate crest anteriorly; two minutely serrulate, submedian carinae posteriorly.

Merus of P1 with mostly two (1-3) spines proximally, subterminal claw-like spine on upper margin, occasional spinule on lower margin. Carpus more than half as long as merus, with prominent subterminal spines

Source : MNHN, Paris

on upper and lower margins. Upper margin of propodus granulate, spinose, subterminal spine long; lower margin with two minutely granulate rows. P5 subchelate in male, chelate in female.

ETYMOLOGY. — The Latin *aculeatus* (= sharp, pointed) refers to the prominently spinose anterior margin of the second abdominal pleuron.

REMARKS. — *P. aculeatus* is distinguished from the closely allied *auriculatus* and *surdus* in having the second pleuron anteriorly triangulate, and a single antrorse spine midway between the median postcervical and the branchial carinae on the posterior margin of the cervical groove.

According to GRIFFIN & STODDART (1995: 247) "The east Australian specimens differ from Alcock's original descriptions of *S. phosphorus* in having two spines on the antero-external angle of the basal antennular segment instead of one, and nine to thirteen spines on the lateral edges of the carapace (behind the cervical groove) instead of six or seven.... also differ in having a conical tooth, quite large in some specimens, projecting from the frontal wall of the carapace but concealed by dense setae". The accompanying photograph (fig. 11) clearly shows the anteriorly triangulate second pleuron typical of *P. aculeatus*.

DISTRIBUTION. — Vanuatu, New Caledonia, Loyalty Is, Chesterfield Is, Indonesia, Australia (NW Coast), East China Sea; 144 m (present work) - 1053 m (GRIFFIN & STODDART, 1995).

Polycheles auriculatus (Bate, 1878)

Fig. 12

Pentacheles auriculatus Bate, 1878a: 280; 1878b: 484; 1878c: 563.
Stereomastis auriculata - BATE, 1888: 159. — DE MAN, 1916: 4 (list). — SUND, 1920: 224. — BERNARD, 1953: 87. — FIRTH & PEQUEGNAT, 1971: 64. — DAWSON, 1997: 17.
Pentocheles auriculata - BATE, 1888, pl. 16 figs 3-4 [erroneous spelling].
Polycheles auriculatus - BOUVIER, 1917: 35 (list).
Stereomastis phosphorus - GRIFFIN & STODDART, 1995: 246, figs 9-11 (p.p.).

MATERIAL EXAMINED. — **Marquesas Islands**. *Eiao.* MUSORSTOM 9: stn CP 1278, 7°52'S, 140°39'W, 1000 m, 5.09.1997: 3 juvs (MNHN).

Fiji Islands. *"Challenger"*: stn 174c, Kandavu I., 19°07.50'S, 178°19.35'E, 1116 m, 3.08.1874: 1 ♂ 21.7 mm (NHM 1888.22).

MUSORSTOM 10: stn CP 1309, 17°32.05'S, 178°53.24'E, 830 m, 5.08.1998: 2 ♂ 25.0, 39.8 mm; 3 juvs (MNHN).

Vanuatu. MUSORSTOM 8: stn CC 991, 18°51.26'S, 168°52.19'W, 936-910 m, 24.09.1994: 1 ♀ 53.7 mm (MNHN-Pa 1424). — Stn CC 1124, 15°01.72'S, 166°56.51'W, 532-599 m, 9.10.1994: 1 juv. (MNHM-Pa 1680). — Stn 1125, 15°57.63'S, 166°38.43'W, 1160-1220 m, 10.10.1994: 1 juv. (MNHN-Pa 1461). — Stn CP 1126, 1 juv. (MNHN-Pa 1462).

New Caledonia. BATHUS 1: stn CP 651, 21°41.8'S, 166°40.1'E, 1080-1180 m, 11. 03.1993: 1 ♀ 20.6 mm (MNHN-Pa 1464). — Stn CP 661, 21°05'S, 165°50.05'E, 960-1100 m, 13.03.1993: 2 ♂ 20.5, 20.9 mm; 1 ♀ 17.3 mm (MNHN-Pa 1465).

BATHUS 2: stn CP 751, 22°24.35'S, 166°12.83'E, 1300-1500 m, 15.05.1993: 1 ♀ 24.8 mm (MNHN-Pa 1466). — Stn CP 767, 22°10'S, 165°59'E, 1060-1450 m, 17.05.1993: 2 ♂ 24.3, 31.2 mm; 3 ♀ 19.7-22.7 mm (MNHN-Pa 1467).

Philippines.*"Albatross"*: stn 5467, Lagonoy Gulf, San Bernardino Str., 13°35'27"N, 123°37'18"E, 864 m, 18.06.1909: 1 ♀ 23.4 mm (USNM). — Stn 5468, 13°35'30"N, 123°40'28"E, 1024 m, 18.06.1909: 2 ♂ 31.5, 40.2 mm; 1 ♀ 29.8 mm (USNM).

Australia. *Torres Str. "Franklin",* 10°37.17'S, 144°21.99'E, 990-1053 m, 21.08.1988, id. H.E. STODDART as *Stereomastis phosphorus*: 1 ♂ 31.6 mm (AM P44920).

North West coast. "Solea": N.W. of Port Hedland, 18°42'S, 116°21'E, 694-704 m, 5.04.1982: 1 ♂ 45.3 mm (WAM C23583). — 18°40'S, 116°27'E, 720-724 m, 5.04.1982: 1 ♂ 44.2 mm; 1 ♀ 31.7 mm (WAM C13435). — 18°45'S, 116°26.5'E, 590-592 m, 4.04.1982: 2 ♀ 52.6, 54.1 mm (WAM C13434). — 18°41'S, 116°29.5'E, 696-704 m, 6.05.1982: 1 ♂ 47.7 mm (WAM C13433).

"Southern Surveyor": Exmouth Plateau, 20°55.4'S, 112°51.5'E, 1139-1128 m, 23.1.1991: 1 ♀ 28.4 mm (TM G3779). — 20°16.5'S, 113°13.5'E, 913 m, 23.1.1991: 2 ov. ♀ 47.9, 51.2 mm (TM G3778).

West coast. "Southern Surveyor": W. of Cape Farquhar, 23°44.6'S, 112°35.5'E, 612-620 m, 26.1.1991: 1 ♀ 55.0 mm (TM G3780). — W. of Freycinet Estuary, 26°40.4'S, 112°32.7'E, 478-456 m, 30.1.1991: 1 ♀ 45.1 mm (TM G3843).

Source : MNHN, Paris

Western Australian Basin. *"Lira"*: 22°08'S, 113°02'E, 880 m, 7.05.1973, coll. O. PETROV: 2 ♀ 51.4, 53.2 mm (ZMMU). — 20°10.3'S, 112°58.1'E, 880-862 m, 7.05.1973, coll. O PETROV: 2 ♀ 56.4, 38.3 mm (ZMMU).

TYPE. — The male (21.7 mm cl) (NHM 1888.22) collected by the *"Challenger"* stn 174c, off Kandavu I., Fiji, (19°07.50'S, 178°19.35'E, 1116 m) is the holotype.

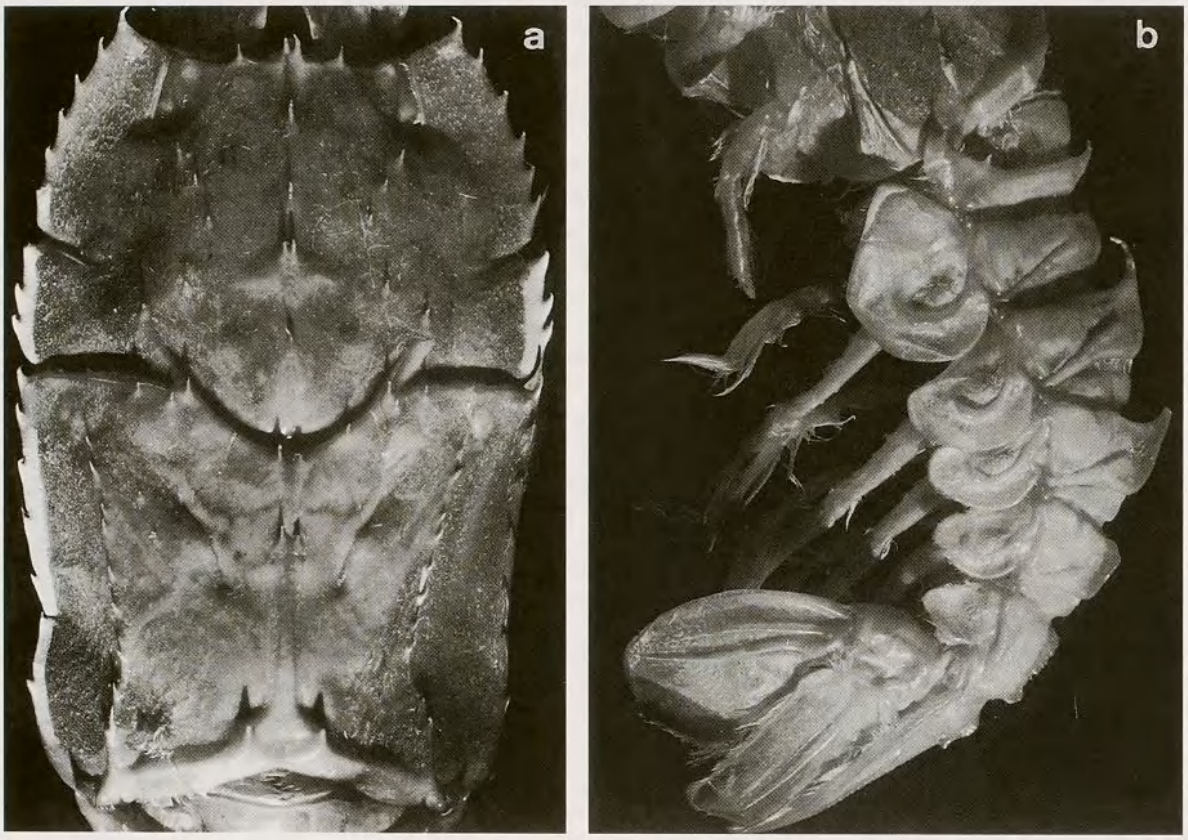

FIG. 12. — *Polycheles auriculatus* (Bate, 1878), ♀ 51.4 mm, West Australian Basin, *"Lira"*, 22°08'S, 113°02'E, 880 m (ZMMU): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

DESCRIPTION. — Carapace oblong, lateral margins subparallel, slightly convergent anteriorly. Dorsal surface of carapace tomentose. Anterior margin of carapace straight. Median submarginal tooth upcurved, in front of small, bifid rostrum. Internal angle of orbital sinus bearing small spine, external angle unarmed. Eyestalk with mammilate spine, curved distad. Basal antennular segment produced anteriorly to a sharp point, mesial margin smooth; antero-external margin bispinose, anterior spine twice as long as posterior. Lateral spines decreasing successively in size posteriorly; spine formula 6-7:3:7. Spine formula of median postrostral carina 1:1:2:1; postcervical carina with two pairs of spines. Posterior margin of cervical groove with 3 or 4 antrorse spines midway between median postcervical and branchial carinae. Gastro-orbital region bearing five spines in curved row, posteriormost spine largest. Branchial carina sinuous, bearing 10 spinules, posteriormost largest. Carapace between branchial and median postcervical carinae minutely granulate. Posterior margin of carapace bearing two prominent, antrorse, submedian spines.

Anterior margin of first abdominal tergite bearing two pairs of lateral spines. Abdominal tergites medially carinate; carinae of tergites 1-4 bearing antrorse spine; spine of third tergite elongate, salient, longer than the one of fourth; carina of fifth tergite simple; sixth tergite bearing prominent, denticulate, lyre-shaped carina. Tergites 2-5 with marked oblique submedian grooves. Pleura 2-5 with curved rib mesially. Anterior pleuron anteriorly produced, ovate. Telson with short, denticulate, crest anteriorly, two minutely serrulate submedian carinae posteriorly.

Source : MNHN, Paris

Merus of P1 bispinose proximally, with subterminal claw-like spine on upper margin. Carpus, more than half as long as merus, with prominent subterminal spines on upper and lower margins. Upper margin of propodus smooth, except for a subterminal spine; lower margin with two minutely granulate rows. P5 subchelate in male, chelate in female.

REMARKS. — *P. auriculatus* differs from the closely allied *P. surdus* in having the lateral margins of carapace posterior to postcervical incision bearing 7 spines rather than 10-14; the branchial carinae with 10 spines rather than 5 or 6; the submedian grooves on the abdominal tergites well marked rather than obsolescent; and the sixth abdominal tergite bearing prominent rather than obsolescent carinae.

The single specimen collected by the *"Challenger"* was a juvenile male. SUND (1920: 224) was mistaken in describing the holotype as female. Comparing the type specimen with BATE's drawing, a discrepancy is apparent in the form of the second pleuron and the pleural mid rib. BATE (1878a: 161) described the "Coxal plates ridged with markings like small ears," or (1888: 161) as "an elevated line or ridge that somewhat resembles in form the outline of the human ear" however, the rib appears in the illustration bow-like (pl. 16, fig. 4).

DISTRIBUTION. — Marquesas Is, Fiji Is, Vanuatu, New Caledonia, Philippines, Australia, Western Australian Basin. 532-1500 m.

Polycheles baccatus Bate, 1878

Fig. 13

Polycheles baccatus Bate, 1878a: 278; 1878b: 484; 1878c: 563. — DE MAN, 1916: 26, pl. 1 figs 4, 4a. — BOUVIER, 1917: 35 (list). — GUNTHER & DECKERT, 1950: 6. — BERNARD, 1953: 86. — FIRTH & PEQUEGNAT, 1971: 41. — GRIFFIN & STODDART, 1995: 238.

Polycheles baccata - BATE, 1888: 131, fig. 32, pl. 14 fig. 1. — STEBBING, 1893: 200. — HICKSON, 1894: 136, fig. 18. — SUND, 1920: 226.

Polycheles buccatus - ZARENKOV, 1983: 110, fig. 46 [erroneous spelling].

not *Polycheles baccatus* - CHAN & YU, 1989: 168, pl. 1 figs c-d; 1993: 109 [= *P. coccifer* sp. nov.].

MATERIAL EXAMINED. — **Wallis and Futuna Islands area**. MUSORSTOM 7. *Wallis Is*: stn DW 606, 13°21'S, 176°08'W, 420-430 m, 22.05.1992: 1 ♀ 31.8 mm (MNHN-Pa 1469).

Banc Tuscarosa: stn DW 555, 11°47'S, 178°19'W, 540-542 m, 19.05.1992: 1 ♂ 26.6 mm (MNHN-Pa 1470). — Stn CP 559, 11°48'S, 178°19'W, 547-552 m, 19.05.1992: 5 ♂ 16.6-30.0 mm; 1 ♀ 36.2 mm (MNHN-Pa 1471).

Banc Bayonnaise: stn DW 625, 11°52'S, 179°34'W, 425-430 m, 29.05.1992: 1 ♂ 31.5 mm (MNHN-Pa 1472). — Stn DW 627, 11°54'S, 179°31'W, 597-600 m, 29.05.1992: 5 m 17.3-21.4 mm, 6 ♀ 19.0-25.0 mm; 9 juvs (MNHN-Pa 1473). — Stn CP 629, 11°54'S, 179°32'W, 400-420 m, 29.05.1992: 2 ♂ 17.6, 21.5 mm; 2 juvs (MNHN-Pa 1474). — Stn CP 630, 11°54'S, 179°32'W, 500 m, 29.05.1992: 1 ♂ 23.7 mm (MNHN-Pa 1475). — Stn CP 631, 11°54'S, 179°32'W, 600 m, 29.05.1992: 2 ♂ 16.8, 19.0 mm; 1 ♀ 21.3 mm (MNHN-Pa 1476). — Stn CP 632, 11°54'S, 179°31'W, 595-600 m, 29.05.1992: 1 ♂ 19.4 mm; 4 ♀ 21.1-31.9 mm (MNHN-Pa 1477).

Fiji Islands. Matuku I. *"Challenger"*: stn 173, 19°09.35'S, 179°41.50'E, 567-576 m, 24.07.1874: 3 ♂ 17.5-27.8 mm; 3 ♀ 16.9-29.3 mm (NHM 1888.22).

Vanuatu. MUSORSTOM 8: stn DW 1014, 17°54.53'S, 168°19.08'E, 495-498 m, 27.09.1994: 1 ♂ 28.8 mm (MNHN-Pa 1478). — Stn CP 1089, 15°08.82'S, 167°17.23'E, 494-516 m, 6.10.1994: 1 juv. (MNHN-Pa 1479). — Stn CP 1111, 14°51.09'S, 167°14.00'E, 1210-1250 m, 8.10.1994: 1 ♂ 28.6 mm (MNHN-Pa 1480).

New Caledonia. MUSORSTOM 4: stn CP 169, 18°54.03'S, 163°11.20'E, 575-600 m, 17.09.1985: 3 ♂ 15.9-24.6 mm; 1 ♀ 24.2 mm, 3 juvs (MNHN-Pa 1481). — Stn 200, 18°53.8'S, 163°14.1'E, 535 m, 20.09.1985: 1 ♀ 25.5 mm (MNHN-Pa 1482). — Stn 202, 18°58'S, 163°59.3'E, 560 m, 20.09.1985: 4 ♂ 24.6-32.7 mm; 3 ♀ 32.9-38.8 mm (MNHN-Pa 1483). — Stn 236, 22°11.35'S, 167°15'E, 495-550 m, 2.10.1985: 1 ♀ 36.4 mm (MNHN-Pa 1484).

HALIPRO 1: stn CP 872, 23°02'S, 166°52'E, 620-702 m, 30.03.1994: 1 ♀ 29.0 mm (MNHN-Pa 1488).

BATHUS 4: stn 909, 18°57.64'S, 163°10.30'E, 516-558 m, 4.08.1994: 2 ♀ 33.2, 37.0 mm (MNHN-Pa 1489). — Stn 911, 18°57.80'S, 163°08.47'E, 566-558 m, 5.08.1994: 1 ♂ 33.3 mm (MNHN-Pa 1490). — Stn 921, 18°46.72'S, 163°17.81'E, 613-610 m, 6.08.1994: 1 ♀ 29.4 mm (MNHN-Pa 1491).

Chesterfield Islands. MUSORSTOM 5: stn 383, 19°40.85'S, 158°46.10'E, 615-600 m, 21.10.1986: 3 ♂ juvs 17.5-20.7 mm (MNHN-Pa 1486).

Australia. *New South Wales*. *"Kapala"*: off Newcastle, 360-540 m, 27-29.04.1971: 1 ov. ♀ 35.9 mm (WAM C13430). — Stn K77-13-12, 29°52'S, 153°43'E, 495 m, 23.08.1977, id. D.E. BROWN: 1 ♂ 34.8 mm (AM P26549). — Stn K78-17-21, 28°37'S, 153°50'E, 502 m, 19.08.1978, id. H.E. STODDART: 1 ♀ 33.5 mm (AM P44749).

Source : MNHN, Paris

Philippines. MUSORSTOM 1: stn CP 50, 13°49.2'N, 120°01.8'E, 415-510 m, 25.03.1976: 1 ♂ 26.4 mm (MNHN-Pa 1492).

MUSORSTOM 2: stn CP 75, 13°50.5'N, 120°30.3'E, 300-330 m, 1.12.1980: 1 ♀ 19.4 mm (MNHN-Pa 1493).

MUSORSTOM 3: stn CP 118, 11°58'N, 121°06'E, 448-466 m, 3.06.1985: 1 juv. (MNHN-Pa 1494).

Indonesia. "*Siboga*": stn 38, Bali Sea, 7°35.4'S, 117°28.6'E, 730-915 m, 1.04.1899: 1 ♂ 26.3 mm; 1 ♀ 26.9 mm (ZMA).

KARUBAR. *Kai Is*: stn CP 17, 5°15'S, 133°01'E, 459-439 m, 24.10.1991: 5 ♂ 19.8-23.8 mm; 7 ♀ 20.7-27.1 mm; 12 juvs (MNHN-Pa 1496). — Stn CP 25, 5°30'S, 132°52'E, 336-346 m, 26.10.1991: 1 ♀ 35.5 mm (MNHN-Pa 1497). — Stn CP 27, 5°03'S, 132°51'E, 304-314 m, 26.10.1991: 1 ♀ 29.8 mm (MNHN-Pa 1498).

Tanimbar Is: stn CC 42, 7°52'S, 132°42'E, 354-350 m, 28.10.1991: 2 ♂ 30.1. 33.0 mm; 3 ♀ 29.8-32.4 mm (MNHN-Pa 1564).

TYPES. — The male (27.8 mm cl) (NHM 1888.22) collected by the *"Challenger"* stn 173, off Matuku I., Fiji (19°09.35'S, 179°41.50'E, 567-576 m), is the lectotype; all other specimens from that sample are paralectotypes.

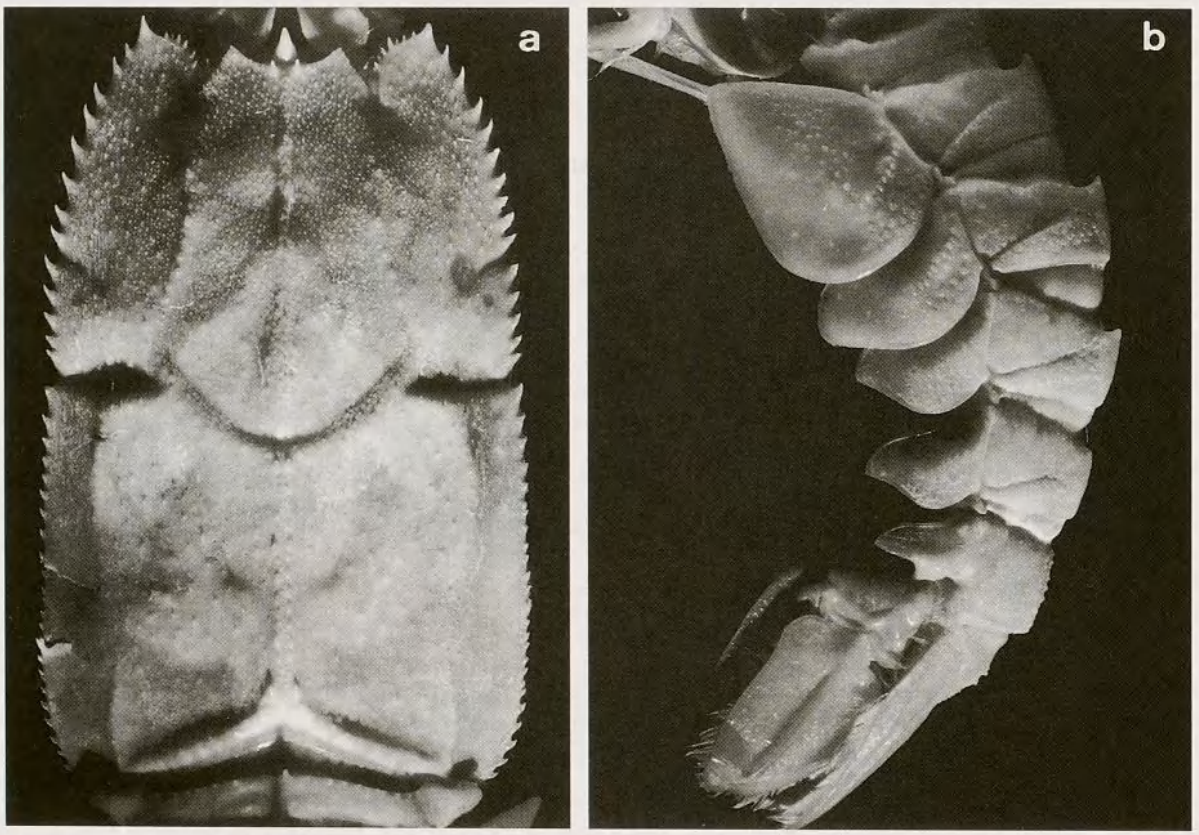

FIG. 13. — *Polycheles baccatus* Bate, 1878, ♂ 32.7 mm, New Caledonia, MUSORSTOM 4, stn 202, 18°58'S, 163°59.3'E, 560 m (MNHN-Pa 1483): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

DESCRIPTION. — Lateral margins of carapace parallel, slightly convergent anteriorly. Dorsal surface of carapace densely granulose, setose. Frontal margin concave. Median submarginal tooth upcurved, prominent, flanked by two slender rostral spines. Internal angle of orbital sinus produced, triangulate; external angle pectinate, 6-spinose. Eyestalk bearing vermicular tubercle. Basal antennular segment produced anteriorly to a sharp point, mesial margin spinose, antero-external margin with one or more minute spinules. Spines on lateral margins of carapace decreasing successively in size posteriorly; spine formula 10-12:4-6:25-26. Median postrostral carina irregularly granulate; granules on postcervical carina larger, paired. Postorbital carina obsolescent, granulate, bispinose. Posterior margin of cervical groove between branchial carinae granulate. Branchial carina finely granulate. Posterior margin of carapace bearing conic granules, submedian pair largest.

Source : MNHN, Paris

Abdominal tergites granulate. Tergites 2-5 bearing oblique submedian grooves. Anterior margin of first tergite beaded. Tergites 1-4 bearing antrorse beaks; fifth carinate; sixth with submedially two beaded rows, confluent posteriorly. Proximal half of pleura 2-5 granulate, margins smooth. Second pleuron medially scooped; margin anteriorly produced, ovate. Pleura 3-5 with short, curved, granulate rib medially. Telson with granulate tubercle anteriorly; two minutely serrulate, confluent carinae posteriorly.

Merus of P1 minutely serrulate on upper and lower margins, with subterminal claw-like spine on upper margin. Carpus half as long as merus, with two serrulate rows on upper margin; spines on external row more prominent, distal spines largest; spinule subterminally on lower margin. Upper margin of propodus with several rows of antrorse conic granules; lower margin with two distal serrulate rows. P5 simple in male, chelate in female.

Color. — "Dorsal surface of the carapace and abdomen a rich burnt orange, area below lateral edges of carapace and lower half of the abdominal pleura white. Interspaces between abdominal segments as well as grooves in abdominal terga also white. Second to fifth pereopods white, chelae of second and third pereopods pinkish red. Ischium of cheliped pinkish, colour continuing to proximal portion of merus; distal portion of merus, carpus and propodus burnt orange; joints between merus and carpus, carpus and propodus and tips of fingers whitish". (GRIFFIN & STODDART, 1995).

REMARKS. — BATE's (1878a: 278) preliminary description, though brief and inaccurate, presents the essential characters of *P. baccatus*: "armed with teeth on the inner side of the antero-lateral angle, central ridge projected into a rostriform tooth supported by two small teeth;...Pleon carinated on each of the four anterior somites and projected into an anteriorly pointed tooth". DE MAN's (1916) description is detailed and meticulous, pointing out many of BATE's inaccuracies.

CHAN & YU (1989: 110) clearly describe another species (*P. coccifer*) which has the "anterolateral angles armed with 2-3 strong spines... Abdominal pleuron II with anterior margin sharply pointed".

DISTRIBUTION. — Wallis Is, Melanesia, Fiji Is, Vanuatu, New Caledonia, Australia (east coast), Philippines, Indonesia, 300-1250 m.

Polycheles ceratus (Alcock, 1894)

Fig. 14

Pentacheles sp. WOOD-MASON, 1891: 19.
Pentacheles cerata Alcock, 1894: 241. — WOOD-MASON & ALCOCK, 1894, pl. 8 fig. 1.
Polycheles cerata - ALCOCK, 1899: 33.
Polycheles ceratus - ALCOCK 1901b: 170. — BOUVIER, 1917: 35.
Stereomastis cerata - DE MAN, 1916: 4 (list). — BERNARD, 1953: 87. — FIRTH & PEQUEGNAT, 1971: 64. — DAWSON, 1997: 18.
Pentacheles certa - DAWSON, 1997: 74 [erroneous spelling].

MATERIAL EXAMINED. — **Indonesia**. *Sumatra. "Te Vega"*: stn 96, 3°25'N, 95°40'E, 1150 m, 21.11.1963: 1 ♀ 33.5 mm (RMNH).

Andaman Sea. *"Investigator"*: stn 114, 13°21'N, 93°27'E, 1686 m: 1 ♀ 32 mm (IM 6880/9). — Stn 310, 13°29'30"N, 95°29'E, 1757 m, 5.11.1902: 1 ♀ 33 mm (IM).

TYPE. — The female (32 mm cl) (IM 6880/9) collected by the *"Investigator"* stn 114 in the Andaman Sea (13°21'N, 93°27'E, 1686 m) is the holotype.

DESCRIPTION. — Lateral margins subparallel, slightly convergent anteriorly. Dorsal surface of carapace smooth, nearly glabrous. Frontal margin straight. Rostrum short, bifid. Internal and external angles of orbital sinus unarmed. Eyestalk without vermicular tubercle. Basal antennular segment with mesial margin smooth, antero-external margin bispinose. Spine formula of lateral margin of carapace 5-6:2:3; lateral margins of carapace posterior to postcervical incision smooth. Median postrostral carina set with antrorse spines; spine formula 1:1:2:1. Pair of antrorse spines medially on posterior margin of cervical groove. No postorbital carina and spines.

Source : MNHN, Paris

Small spine on posterior margin of cervical groove at junction of anterior and posterior branches. Branchial carina distinct, unarmed. Posterior margin of carapace with pair of antrorse submedian spines.

Abdominal tergites smooth. Oblique submedian grooves on tergites 2-5 obsolescent. Anterior margin of first tergite smooth. Tergites 2-5 medially crested; tergites 2-4 with small antrorse spine; fifth tergite with large, ram-like, antrorse spine reaching forward beyond fourth tergite. Sixth tergite bearing mesially parallel pair of rounded carinae, confluent posteriorly. Pleura nearly smooth; second pleuron anteriorly produced, ovate. Telson with obsolete tubercle anteriorly, two smooth confluent carinae posteriorly.

Merus of P1 smooth. Carpus half as long as merus with subterminal spine on upper and lower margins. Upper margin of propodus with two subterminal spines. P5 chelate in female.

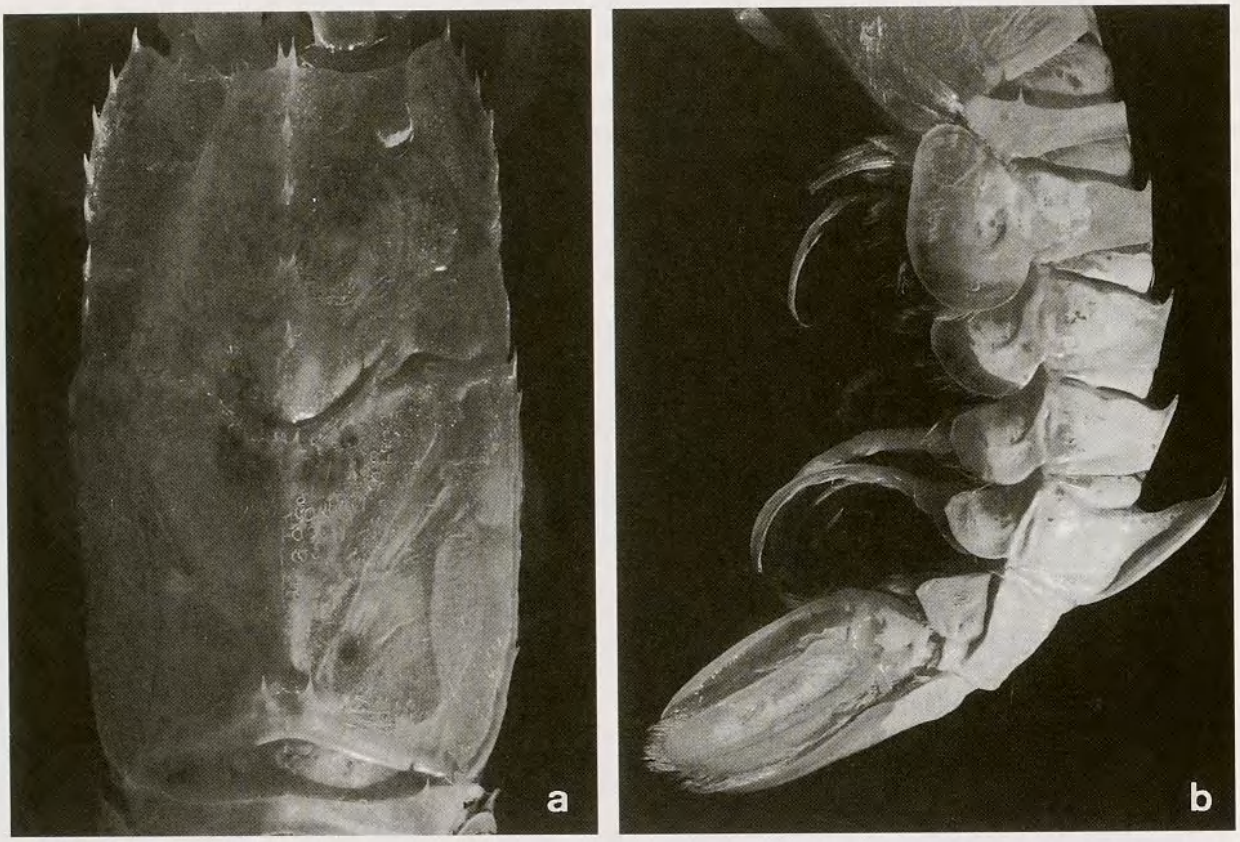

FIG. 14. — *Polycheles ceratus* (Alcock, 1894), ♀ 33.5 mm, Sumatra, *"Te Vega"*, stn 96, 3°25'N, 95°40'E, 1150 m (RMNH): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

REMARKS. — *P. ceratus* is easily distinguished from its congeners by the large antrorse spine on fifth abdominal tergite, overhanging the anterior margin of the fourth tergite.

DISTRIBUTION. — Known from Sumatra (Indonesia) and the Andaman Sea, 1150-1757 m.

Polycheles coccifer sp. nov.

Fig. 15

Polycheles baccatus – TUNG *et al.*, 1988: 47, pl. 46. — CHAN & YU, 1989: 168, pl. 1 figs c-d; 1993: 109 [non Bate, 1878].

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn CP 1123, 15°07.19'S, 166°55.20'E, 262-352 m, 9.10.1994: 1 juv. (MNHN-Pa 1500).

Source : MNHN, Paris

New Caledonia. MUSORSTOM 4: stn 247, 22°09'S, 167°13.3'E, 435-460 m, 4.10.1985: 1 ♂ 40.6 mm (MNHN-Pa 1499).

HALIPRO 1: stn CP 868, 21°14.53'S, 165°55.84'E, 430-450 m, 21.03.1994: 1 ♂ 26.1 mm (MNHN-Pa 1501).

BATHUS 1: stn CP 698, 20°34.2'S, 164°57.3'E, 491-533 m, 17.03.1993: 2 ♂ 34.5, 38.3 mm; 3 ♀ 27.6-40.5 mm (MNHN-Pa 1502).

BATHUS 4: stn 947, 20°33.72'S, 164°57.72'E, 470-490 m, 10.08.1994: 3 ♀ 30.2-33.5 mm; 4 juvs (MNHN-Pa 1503). — Stn 948, 20°33.13'S, 164°57.03'E, 533-610 m, 10.08.1994: 1 ♂ 39.7 mm; 1 ♀ 40.1 mm; 1 juv. (MNHN-Pa 1504).

Indonesia. KARUBAR. *Kai Is*: stn CP 16, 5°17'S, 132°50'E, 315-349 m, 24.10.1991: 1 ♀ 44.6 mm (MNHN-Pa 1733).

Tanimbar I.: stn CC 42, 7°53'S, 132°42'E, 354-350 m, 28.10.1991: 1 ♀ 46.7 mm (MNHN-Pa 1511). — Stn CP 62, 9°01'S, 132°42'E, 246-253 m, 1.11.1991: 3 ♂ 39.8-44.6 mm; 2 ♀ 37.1, 47.9 mm (MNHN-Pa 1512). — Stn CP 78, 9°06'S, 131°24'E, 295-284 m, 3.11.1991: 2 ♀ 43.7, 45.8 mm (MNHN-Pa 1513). — Stn CP 79, 9°16'S, 131°22'E, 250-239 m, 3.11.1991: 1 ♂ 33.4 mm; 1 ♀ 53.8 mm (MNHN-Pa 1514).

Philippines. "*Albatross*": stn 5112, Luzon, 13°48'22"N, 120°47'25"E, 319 m, 17.01.1908: 2 ♂ 25.5, 33.5 mm; 2 ♀ 34.6, 37.2 mm (USNM). — Stn 5118, Balayan Bay, 13°48'45"N, 120°41'51"E, 284 m, 21.01.1908: 1 ♀ 38.3 mm (USNM). — Stn 5221, btw Marinduque and Luzon, 13°38'15"N, 121°48'15"E, 351 m, 24.04.1908: 3 ♂ 28.2-40.1 mm; 2 ♀ 30.1, 57.2 mm (USNM). — Stn 5222, btw Marinduque and Luzon, 13°38'30"N, 121°42'45"E, 351 m, 24.04.1908: 1 ♀ 21.5 mm (USNM). — Stn 5256, Illana Bay, Bongo I., 7°21'45"N, 124°07'15"E, 284 m, 22.05.1908: 1 ♂ 22.7 mm; 2 ♀ 25.2, 46.7 mm (USNM). — Stn 5289, Luzon, 13°41'50"N, 120°58'30"E, 310 m, 21.07.1908: 1 ♀ 30.1 mm (USNM). — Stn 5297, Luzon, 13°41'20"N, 120°58'E, 356 m, 24.07.1908: 1 dry (USNM). — Stn 5364, Luzon, Balayan Bay, 13°48'30"N, 120°43'45"E, 288 m, 20.02.1909: 10 ♂ 19.8-34.5 mm; 1 ♀ 18.1-28.0 mm (USNM). — Stn 5365, Luzon, Balayan Bay, 13°44'24"N, 120°45'30"E, 385 m, 22.02.1909: 1 ♀ 56.1 mm (USNM). — Stn 5374, Marinduque I., 13°45'45"N, 121°35'08"E, 342 m, 2.03.1909: 3 ♂ 17.5-37.0 mm; 4 ♀ 17.7-39.3 mm (USNM). — Stn 5421, btw Panay and Guimaras, 10°33'30"N, 122°26'E, 247 m, 30.03.1909: 1 ♂ 25.1 mm; 1 ♀ 45.9 mm (USNM). — Luzon, Balayan Bay, Calaca Town, 13°44'N, 120°45'E, 99-177 m, 24.06.1966: 1 ♂ 41.9 mm; 1 ♀ 30.9 mm (USNM 322873). — Nouongcasto, 13°44'N, 120°45'E, 144-155 m, 25.06.1966: 2 ♂ 26.8, 33.5 mm (USNM 322873). — S. of Sapating, 13°44'N, 120°45'E, 266-301 m, 29.07.1966: 2 ♂ 27.3, 37.7 mm; 1 juv. (USNM 322873).

MUSORSTOM 1: stn 42, 13°55.1'N, 120°28.6'E, 379-407 m, 24.03.1976: 1 ♀ damaged (MNHN-Pa 1505).

MUSORSTOM 2: stn CP 26, 13°49.6'N, 120°51.0'E, 299-320 m, 23.11.1980: 8 ♂ 23.6-33.4 mm; 7 ♀ 25.1-48.2 mm (MNHN-Pa 1506). — Stn CP 74, 13°54'N, 120°27'E, 300-370 m: 1 ♀ 47.9 mm (MNHN-Pa 1507).

MUSORSTOM 3: stn CP 105, 13°52'N, 120°30'E, 398-417 m, 1.06.1985: 2 ♂ 20.0, 25.0 mm; 1 ♀ 50.4 mm; 1 juv. (MNHN-Pa 1508). — Stn CP 119, 11°59'N, 121°13'E, 320-337 m, 3.06.1985: 1 ♂ 36.3 mm (MNHN-Pa 1509). — Stn CP 125, 11°57'N, 121°28'E, 388-404 m, 4.06.1985: 19 ♂ 22.7-38.1 mm; 16 ♀ 24.7-51.6 mm; 14 juvs (MNHN-Pa 1510).

Taiwan. Tai chi, I-lan County, 300 m, 10.06.1993, coll. & id. T.Y. CHAN as *P. baccatus*: 1 ♂ 34.3 mm (NTOU).

TYPE. — The male (36.3 mm cl) (MNHN-Pa 1509) collected by MUSORSTOM 3 at stn 119 (11°59'N, 121°13'E, 320-337m) in the Philippines is the holotype.

DESCRIPTION. — Lateral margins of carapace parallel, slightly convergent anteriorly. Dorsal surface of carapace densely granulose, tomentose. Frontal margin concave. Median submarginal tooth upcurved, prominent, reaching considerably beyond pair of non contiguous rostral spines. Internal angle of orbital sinus produced, triangulate; external angle bispinose, occasionally with auxillary spinules. Eyestalk bearing vermicular tubercle. Basal antennular segment produced anteriorly to a sharp point, mesial margin minutely serrulate, antero-external margin tuberculate. Spine formula of lateral margins of carapace 6-7:4-6:20-23, spines decreasing in size posteriorly. Median postrostral carina set with antrorse mammilate tubercles; postcervical carina set with larger granules, paired, anteriormost largest. Postorbital carina obsolescent, quadrispinose, anteriormost spine largest. Posterior margin of cervical groove between branchial carinae granulate. Branchial carina serrulate. Posterior margin of carapace granulate, with pair of antrorse submedian spines.

Abdominal tergites granulate; tergites 2-5 with transversely oblique submedian grooves. Anterior margin of first tergite irregularly beaded. Tergites 1-4 bearing antrorse spines; fifth crested; sixth bearing submedially two beaded rows, confluent posteriorly. Proximal 3/4 of pleura 2-5 granulate, margins granulate. Second pleuron medially scooped, margin anteriorly triangulate. Pleura 3-5 with short, curved, granulate rib medially. Telson with granulate tubercle anteriorly; two minutely serrulate, confluent carinae posteriorly.

Merus of P1 spinulate on upper margin with longer proximal spines and subterminal claw-like spine, minutely serrulate on lower margin. Carpus half as long as merus, with two minutely serrulate rows on upper margin and

Source : MNHN, Paris

subterminal spinule on lower margin. Upper margin of propodus minutely granulate, tiny spinules on lower margin. P5 simple in male, chelate in female.

Color. — "Body generally ivory and covered with large patches of orange-red on dorsal surface. Non-articulate surface of dorsal abdomen, posterior parts of abdominal pleura, telson margins and bases of uropods also orange-red. Setae light brown." (CHAN & YU, 1989: 109, color photo).

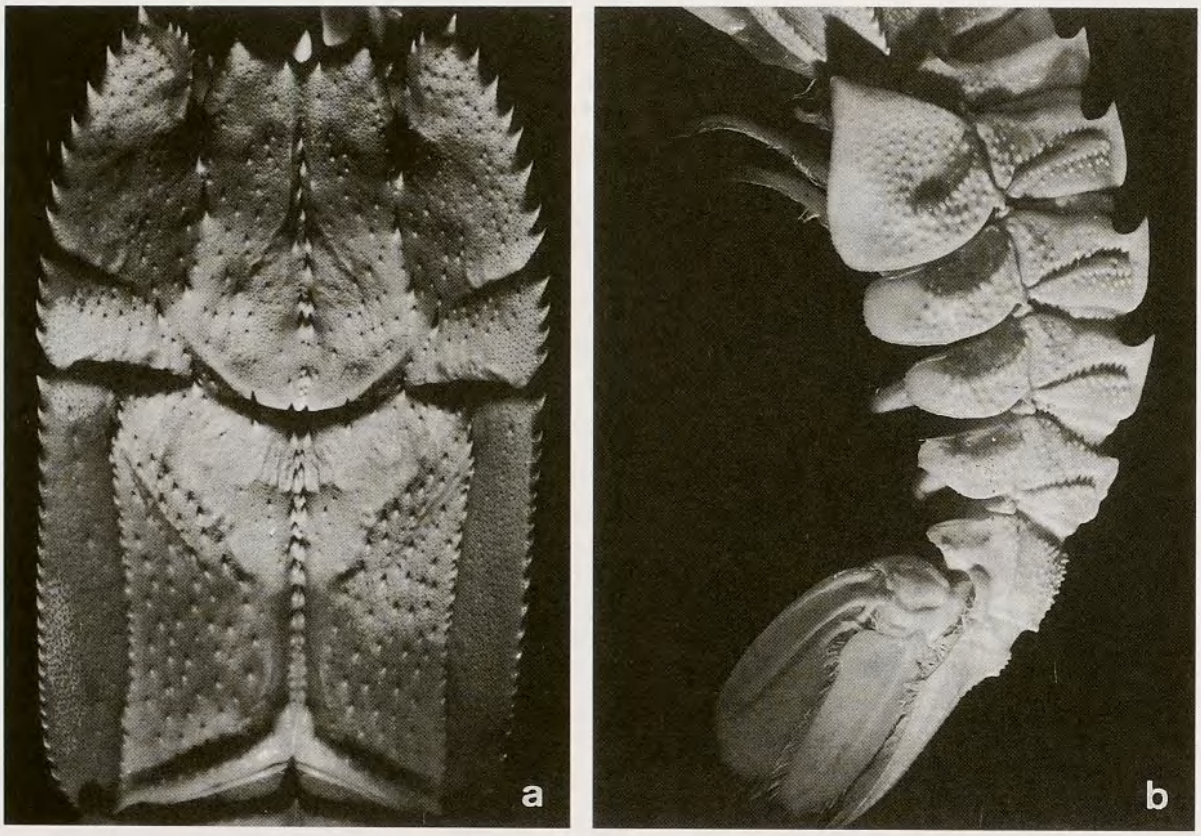

FIG. 15. — *Polycheles coccifer* sp. nov., ♀ 53.8 mm, Indonesia, Tanimbar I., KARUBAR stn 79, 9°16'S, 131°22'E, 250-239 m (MNHN-Pa 1514): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

ETYMOLOGY. — The Latin *coccifer* (= berried) refers to the densely granulose carapace of this species.

REMARKS. — *P. coccifer* is distinguished from its closely related congener, *P. baccatus*, in having the external angle of orbital sinus bispinose, the lateral margins of carapace anterior to cervical incision bearing 6-7 spines, the carpus and propodus of the first cheliped indistinctly granulose, the gastro-orbital carina quadrispinose, and the anterior margin of the second pleuron triangulate.

DISTRIBUTION. — Vanuatu, New Caledonia, Taiwan, Indonesia, Philippines; known reliably between 155-533 m, collected too in trawlings between 99-610 and 533-610 m.

Polycheles enthrix (Bate, 1878)

Fig. 16

Willemoesia euthrix Willemoes-Suhm, 1875c: xxxiii. (see remarks).
Pentacheles enthrix Bate, 1878a: 280, pl. 13 figs 1-3; 1878b: 484; 1878c: 563. — SMITH, 1880b: 272.
Pentacheles anthrax - SMITH, 1880a: 353 [erroneous spelling].

Source : MNHN, Paris

Pentacheles euthrix - BATE, 1888: 149, figs 14-27, 33-36. — STEBBING, 1893: 200. — FAXON, 1895: 119. — HUTTON, 1904: 253. — SUND, 1920: 226.
Polycheles helleri Bate, 1878a: 277 (p.p.); 1878b: 484 (p.p.); 1878c: 563 (p.p.); 1888: 138 (p.p.).
Pentocheles enthrix - BATE, 1888, pl. 17 [erroneous spelling].
Pentacheles helleri - BATE, 1888, pl. 15 fig. 1 [non Bate, 1878].
Polycheles euthrix - DE MAN, 1916: 5 (list). — BOUVIER, 1917: 35 (list). — BERNARD, 1953: 86. — FIRTH & PEQUEGNAT, 1971: 45. — GRIFFIN & STODDART, 1995: 239, figs 2-3. — DAWSON, 1997: 9.
Polycheles enthrix - CHAN & YU, 1993: 107.
Stereomastis kermadecensis Sund, 1920: 224. — BERNARD, 1953: 87.
Polycheles amemiyai Yokoya, 1933: 44, fig. 23. — MIYAKE, 1972: 65; 1982: 190. — TAKEDA, 1982: 38. — DAWSON, 1997: 7.
Polycheles anaemayai - FIRTH & PEQUEGNAT, 1971: 41. — DAWSON, 1997: 78 [erroneous spelling].
Polycheles kermadecensis - FIRTH & PEQUEGNAT, 1971: 49. — DAWSON, 1997: 11.
Stereomastis nana - BABA *et al.*, 1986 pl. 109 [non Smith, 1880].

MATERIAL EXAMINED. — **Wallis and Futuna Is area**. MUSORSTOM 7. *Banc Combe*: stn DW 539, 12°27'S, 177°27'W, 700 m, 17.05.1992: 1 ♀ 59.1 mm (MNHN-Pa 1515). — Stn CC 551, 12°15'S, 177°28'W, 791-795 m, 18.05.1992: 1 ♂ 20.1 mm (MNHN-Pa 1516). — Stn CC 552, 12°16'S, 177°28'W, 786-800 m, 18.05.1992: 1 ♂ 21.7 mm (MNHN-Pa 1517). — Stn CC 553, 12°17'S, 177°28'W, 780-794 m, 18.05.1992: 1 ♀ 31.3 mm (MNHN-Pa 1518). — Stn CC 554, 12°14'S, 177°28'W, 795-820 m, 18.05.1992: 1 ♀ 25.7 mm (MNHN-Pa 1519).

Banc Bayonnaise: stn CP 631, 11°54'S, 179°32'W, 600 m, 29.05.1992: 1 ♀ 54.1 mm (MNHN-Pa 1520). — Stn CP 632, 11°54'S, 179°31'W, 595-600 m, 29.05.1992: 1 ♂ 39.0 mm (MNHN-Pa 1521).

Fiji Islands. "*Challenger*": stn 173, off Matuku I., 19°09.35'S, 179°41.50'E, 576 m, 24.07.1874: 1 ♀ 27.4 mm (NHM 1888.22).

New Caledonia. BIOCAL: stn CP 32, 23°07'S, 166°51'E, 825 m, 28.08.1985: 4 ♀ 24.9-56.3 mm (MNHN-Pa 1536).

BERYX 2: stn CP 58, 23°19.20'S, 167°59.35'E, 850-920 m, 22.10.1992: 1 ♀ 23.7 mm (MNHN-Pa 1537). — Stn CP 59, 23°19.'S, 168°00'E, 750-800 m, 22.10.1992: 1 ♂ 26.2 mm; 1 ♀ 47.6 mm (MNHN-Pa 1538).

BATHUS 1: stn CP 663, 20°58.66'S, 165°38.27'E, 730-780 m, 13.03.1993: 1 ♀ 54.5 mm (MNHN-Pa 1539). — Stn CP 709, 21°41.78'S, 166°37.88'E, 650-800 m, 19.03.1993: 2 ♀ 56.7, 59.5 mm (MNHN-Pa 1540).

BATHUS 2: stn CP 741, 22°35.53'S, 166°26.56'E, 700-950 m, 14.05.1993: 1 ♀ 42.8 mm (MNHN-Pa 1541). — Stn CP 743, 22°35.6'S, 166°26.2'E, 713-950 m, 14.05.1993: 1 ♂ 20.0 mm; 2 ♀ 57.2, 48.0 mm (MNHN-Pa 1542). — Stn CP 765, 22°09.6'S, 166°02.8'E, 600-630 m, 17.05.1993: 1 ♀ 46.6 mm (MNHN-Pa 1543). — Stn CP 766, 22°10'S, 166°01.7'E, 650-724 m, 17.05.1993: 1 ♀ 52.7 mm (MNHN-Pa 1679). — Stn CP 771, 22°09.52'S, 166°01.75'E, 610-800 m, 18.05.1993: 1 ♀ 47.3 mm (MNHN-Pa 1544).

BATHUS 3: stn DW 790, 23°48.94'S, 169°47.60'E, 685-715 m, 25.11.1993: 1 ♀ 29.7 mm (MNHN-Pa 1545). — Stn DW 793, 23°47.50'S, 169°48.75'E, 731-751 m, 26.11.1993: 2 ♂ 26.0-34.5 mm (MNHN-Pa 1546). — Stn DW 794, 23°48.35'S, 169°49.10'E, 751-755 m, 26.11.1993: 1 ♂ 34.1 mm (MNHN-Pa 1547). — Stn CP 831, 23°04'S, 166°56'E, 650-658 m, 30.11.1993: 6 ♂ 23.2-43.1 mm; 2 ♀ 31.2, 45.0 mm (MNHN-Pa 1548). — Stn CP 832, 23°03'S, 166°54'E, 650-659 m, 30.11.1993: 2 ♀ 50.7, 51.7 mm (MNHN-Pa 1549). — Stn CC 841, 23°03'S, 166°53'E, 640-680 m, 30.11.1993: 3 ♂ 26.4-47.7 mm; 7 ♀ 22.0-52.5 mm (MNHN-Pa 1550). — Stn CP 845, 23°03.30'S, 166°59.29'E, 592-622 m, 1.12.1993: 1 ♂ 29.1 mm; 1 ♀ 41.2 mm (MNHN-Pa 1551). — Stn CC 848, 23°02.50'S, 166°52.80'E, 680-700 m, 1.12.1993: 5 ♂ 28.6-46.9 mm; 10 ♀ 40.0-58.5 mm (MNHN-Pa 1552).

HALIPRO 1: stn CP 854, 21°40'S, 166°38'E, 650-780 m, 19.03.1994: 2 ♀ 59.1, 57.8 mm (MNHN-Pa 1554). — Stn CH 872, 23°02'S, 166°52'E, 620-702 m, 30.03.1994: 9 ♂ 28.9-42.7 mm; 10 ♀ 36.3-57.8 mm (MNHN-Pa 1555). — Stn CH 873, 23°01'S, 166°53'E, 640-680 m, 30.03.1994: 1 ♂ 29.7 mm; 2 ♀ 50.8, 57.2 mm (MNHN-Pa 1556). — Stn CH 874, 23°05'S, 166°48'E, 708-830 m, 30.03.1994: 1 ♂ 45.7 mm; 1 ♀ 52.1 mm (MNHN-Pa 1557). — Stn CH 876, 23°10'S, 166°49'E, 870-1000 m, 31.03.1994: 1 ♂ 37.5 mm (MNHN-Pa 1558).

BATHUS 4: stn CP 913, 18°56.23'S, 163°04.86'E, 777-820 m, 5.08.1994: 1 ♂ 32.6 mm; 1 ♀ 43.2 mm (MNHN-Pa 1553).

Loyalty Islands. MUSORSTOM 6: stn DW 483, 21°19.80'S, 167°47.80'E, 600 m, 23.02.1989: 2 ♂ 39.3, 44.5 mm (MNHN-Pa 1535).

Chesterfield Islands. MUSORSTOM 5: stn DC 321, 21°20.40'S, 158°02.20'E, 1000 m, 14.10.1986: 1 juv. 12.2 mm (MNHN-Pa 1522). — Stn CP 323, 21°18.52'S, 157°57.62'E, 970 m, 14.10.1986: 2 ♂ 31.4, 32.2 mm; 2 ♀ 41.6, 48.4 mm; 35 juvs (MNHN-Pa 1523). — Stn CP 359, 19°39.00'S, 158°49.00'E, 700-720 m, 18.10.1986: 1 ♂ 31.8 mm (MNHN-Pa 1524). — Stn CP 360, 19°36.40'S, 158°49.60'E, 770-810 m, 18.10.1986: 1 ♀ damaged; 2 juvs (MNHN-Pa 1525). — Stn CP 363, 19°47.90'S, 158°44.30'E, 700-685 m, 19.10.1986: 1 ♀ 47.3 mm (MNHN-Pa 1526). — Stn CC 365, 19°42.82'S, 158°48.00'E, 710 m, 19.10.1986: 1 ♂ 37.2 mm; 3 ♀ 53.2-65.1 mm (MNHN-Pa 1527). — Stn CC 366, 19°45.40'S, 158°45.62'E, 650 m, 19.10.1986: 2 ♂ 35.2, 22.9 mm; 1 ♀ 37.0 mm (MNHN-Pa 1528). — Stn CC 367, 19°36.80'S, 158°53.20'E, 855-830 m, 19.10.1986: 1 ♂ 42.9 mm; 1 ♀ 31.8 mm (MNHN-Pa 1529). —

Source : MNHN, Paris

Stn CC 383, 19°40.85'S, 158°46.10'E, 615-600 m, 21.10.1986: 2 ♀ 46.7, 52.5 mm (MNHN-Pa 1530). — Stn CC 384, 19°42.40'S, 158°50.80'E, 772-756 m, 21.10.1986: 3 ♂ 13.3-45.2 mm; 6 ♀ 15.8-59.3 mm (MNHN-Pa 1531). — Stn DC 385, 20°53.60'S, 160°49.40'E, 740-750 m, 22.10.1986: 1 ♂ 23.2 mm (MNHN-Pa 1532). — Stn CP 386, 20°56.21'S, 160°51.12'E, 770-755 m, 22.10.1986: 2 juvs 14.6, 15.4 mm (MNHN-Pa 1533). — Stn CP 387, 20°53.41'S, 160°52.41'E, 650-660 m, 22.10.1986: 1 juv. 14.4 mm (MNHN-Pa 1534).

Kermadec Is. "*Challenger*": stn 170, 29°55'S, 178°14'E, 951 m, 14.07.1874: 1 ♀ 15.3 mm (NHM 1888.22). — Stn 170a, 29°45'S, 178°11'W, 1152 m, 14.07.1874: 1 ♀ 22.0 mm, badly broken specimen (NHM 1888.22).

New Zealand. NZOI: stn K5804, 29°14.8'S, 177°49.6'W, 590-490 m, 22.07.1974: 2 juvs (NIWA). — Stn Z8989, 37°32.55'S, 176°48.61'E, 550-577 m, 18.01.1998: 1 ov. ♀ 42.6 mm (NIWA). — Stn Z9263, 34°09.2'S, 162°51.9'E, 791 m, 18.09.1998: 1 ♂ 36.2 mm (NIWA).

Australia. *New South Wales*. *"Kapala"*: stn K78-09-05, 28°02'S, 153°59'E, 549 m, 2.06.1978, id. D.E. BROWN as *P. euthrix*: 1 ♀ 73.2 mm (AM P44750). — Stn K78-23-08, 28°03'S, 154°04'E, 732 m, 6.11.1978, id. H.E. STODDART as *P. euthrix*: 2 ♂ 61.4, 69.5 mm; 1 ♀ 51.2 mm (AM P44754).

East China Sea. *"Yuryo-maru"* (det. Y. MIYA as *Stereomastis nana*): 28°27.20'N, 126°56.36'E, 320-340 m, 7.02.1978: 1 ♀ 62.4 mm (NUM cr.10243). — 25°48'N, 124°25.5'E, 420-400 m, 14.09.1979: 1 ♀ 57.5 mm (NUM cr.10406). — 28°31'N, 126°57'E, 310 m, 12.10.1979: 1 ov. ♀ 60.9 mm (NUM cr.10407).

Taiwan. Su-Aon, I-Lan County, 500 m, 10.04.1991, coll. T.Y. CHAN: 1 ♀ 25.4 mm (NTOU).

Japan.Tosa Bay, 16.01-14.02.1961, coll. K. SAKAI: 1 ♂ 45.7 mm; 1 ♀ 49.3 mm (SMF 24647).

TYPES. —The female (15.3 mm cl) (NHM 1888.22) collected by the *"Challenger"* stn 170 off Kermadec Is (29°55'S, 178°14'E, 951 m) is designated here as the lectotype of *Pentacheles enthrix* Bate, 1878. The female (22.0 mm cl) (NHM 1888.22) collected by the *"Challenger"* off Kermadec Is (stn 170a) is a paralectotype.

About the types of *S. kermadecensis*, see remarks.

DESCRIPTION. — Margins of carapace subparallel, slightly convergent anteriorly. Dorsal surface of carapace setose, minutely granulose, granules more prominent anteriorly. Frontal margin of carapace slightly convex; median submarginal tooth half as long as rostral spines; several spines and spinules on either side of rostral spines. Internal angle of orbital sinus spinose, external angle unarmed. Eyestalk bearing small mammilate spine, curved distad. Basal antennular segment produced anteriorly to a sharp point, mesial margin serrulate, two spines on antero-external angle, lateral spine smaller. Anterolateral angle of carapace prominently produced. Spine formula of lateral margins of carapace 8-9:4-5:12-14. Median postrostral carina ill-defined anteriorly, spine formula 1:1:2:1; postcervical carina with one pair of spines followed by two rows of mammilate tubercules. Gastro-orbital region bearing single spine. Branchial carina sinuous, obsolescent, granulose. Posterior margin of carapace bearing three pairs of antrorse spines, submedian pair largest.

Abdominal tergites without submedian grooves, medially carinate. Carina on tergites 1-4 with antrorse spine; carina on fifth tergite with small tooth; sixth tergite crested distally. Anterior tergite with pair of lateral spines. Pleura with crescentic mid-rib nearly obsolete, margins setose. Second pleuron anteriorly produced, triangulate. Telson with mammilate tubercle anteriorly followed by deep furrow; two smooth, confluent carinae posteriorly.

Merus of cheliped bispinose proximally on upper margin, clawed subterminal spine; lower margin serrulate, proximal spinules longer. Carpus 3/4 as long as merus, upper margin distally granulate, small subterminal spine on lower margin. Upper margin of chela with two serrulate rows, distalmost spine on inner row prominent, lower margin with single serrulate row. P5 subchelate in male, pollex very short; chelate in female.

Color. — Carapace and abdomen red, first chela pale distally (S. O'SHEA, pers. comm.). "Body generally orange-red. Lateral surface and grooves on carapace, antennal and antennular flagella, pereiopods, ventral surface, articulated surface and lateral margins of abdominal tergites slightly orange-red to somewhat whitish" (CHAN & YU, 1993: 107, color photo). Color photo also in BABA, 1986, pl. 109.

REMARKS. — During the *"Challenger"* expedition WILLEMOES-SUHM collected two juvenile female specimens off the Kermadec Is on July 14th, 1874. He described them in his notes (cited in BATE, 1888: 153) and referred to them by name, *Willemoesia euthrix*, in his letter to VON SIEBOLD, sent September 1874 and published in 1875. However, as he failed to include even the briefest description, the name could not be accepted. BATE (1878a), working from WILLEMOES-SUHM's notes, described the species under the name *Pentacheles enthrix*. Including, in addition to the two Kermadec specimens, a male (in fact a female) specimen collected off Matuku I., Fiji. A farther complication arose as it seems that BATE (1878a), in his preliminary account of the Challenger Polychelids, put

Source: MNHN, Paris

down the same female specimen from the Kermadec Islands as syntype of both *Polycheles helleri* and *Pentacheles enthrix* - actually depicting it (BATE, 1888, pl. 15 fig. 1). SUND (1920: 224) recognized that "the other specimens (from stn 170, near Kermadec Islands, N. of New Zealand) is certainly of a species distinct from the type" [from the type of *Polycheles helleri*]. However the species SUND erected, *Stereomastis kermadecensis*, is a junior synonym of *P. enthrix*. BATE's misplacement serves to explain SUND's (1920) confusion as to the number of *enthrix* specimens available to BATE, of which, he reported, only two survived. However, all three syntypes of *P. enthrix* are extant. The three are very young specimens, as attested by their small size and the fact that "The posterior pair of pereiopoda is chelate, the dactylos and pollex being subequal in both sexes" (BATE, 1888: 150) - a condition existing in juveniles.

YOKOYA's (1933) description and illustration leave no doubt that *P. amemiyai* is but a synonym of *enthrix*. Unfortunately, a search in the Kitakyushu Museum for the type was unsuccessful (K. BABA, pers. com).

DISTRIBUTION. — Melanesia, Fiji Is, Kermadec Is, New Caledonia, New Zealand, Australia, East China Sea, Taiwan, Japan; 229 m (GRIFFIN & STODDART, 1995) - 1152 m.

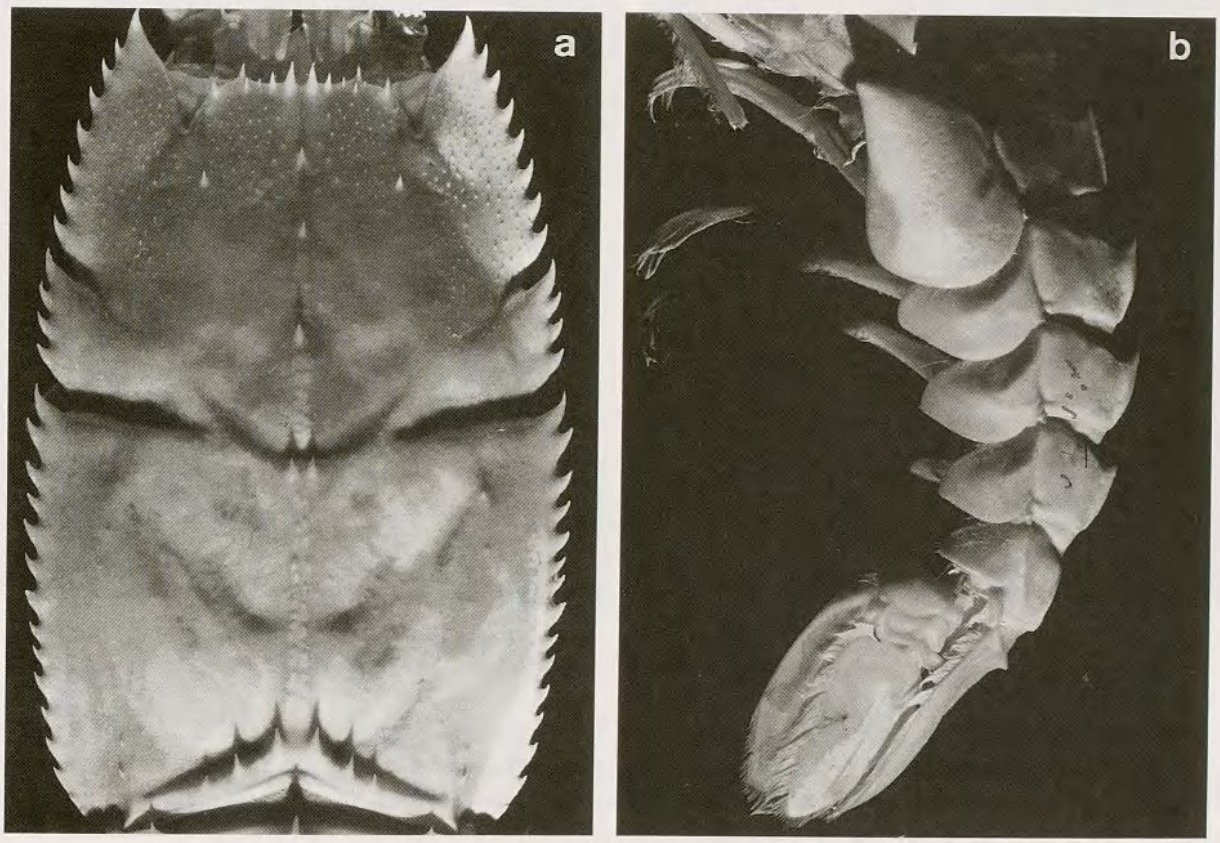

FIG. 16. — *Polycheles enthrix* (Bate, 1878), ♀ 46.7 mm, New Caledonia, MUSORSTOM 5: stn 383, 19°40.85'S, 158°46.10'E, 615-600 m (MNHN-Pa 1530): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

Polycheles evexus sp. nov.

Fig. 17

Polycheles nanus - FAXON, 1895: 121, pl. 33, figs 1, 1a-b [non Smith, 1884].
Stereomastis nana - WICKSTEN, 1989: 304. — HENDRICKX, 1995: 156 [non Smith, 1884].

MATERIAL EXAMINED. — **Peru**. "*Anton Bruun*": stn 766, 04°10'S, 81°27'W, 1860-1815 m, 9.09.1966: 3 ♀ 22.8-23.9 mm (USNM).

Source : MNHN, Paris

Chile. *"Albatross"*: stn 2788, Chonos Arch., 45°35'S, 75°55'W, 1890 m, 11.02.1883, id. M.J. RATHBUN: 3 ♂ 19.7-21.9 mm (USNM 28350). — Stn 2789, Chiloe I., 45°36'S, 75°28'W, 2416 m, 12.02.1883, id. W.L. SCHMITT: 1 spec. damaged (USNM 58644).

TYPES. — The male (21.9 mm cl) (USNM 28350) collected by the *"Albatross"*, stn 2788 off Chile (45°35'S, 75°55'W, 1890 m), is the holotype; the other males from that sample are paratypes.

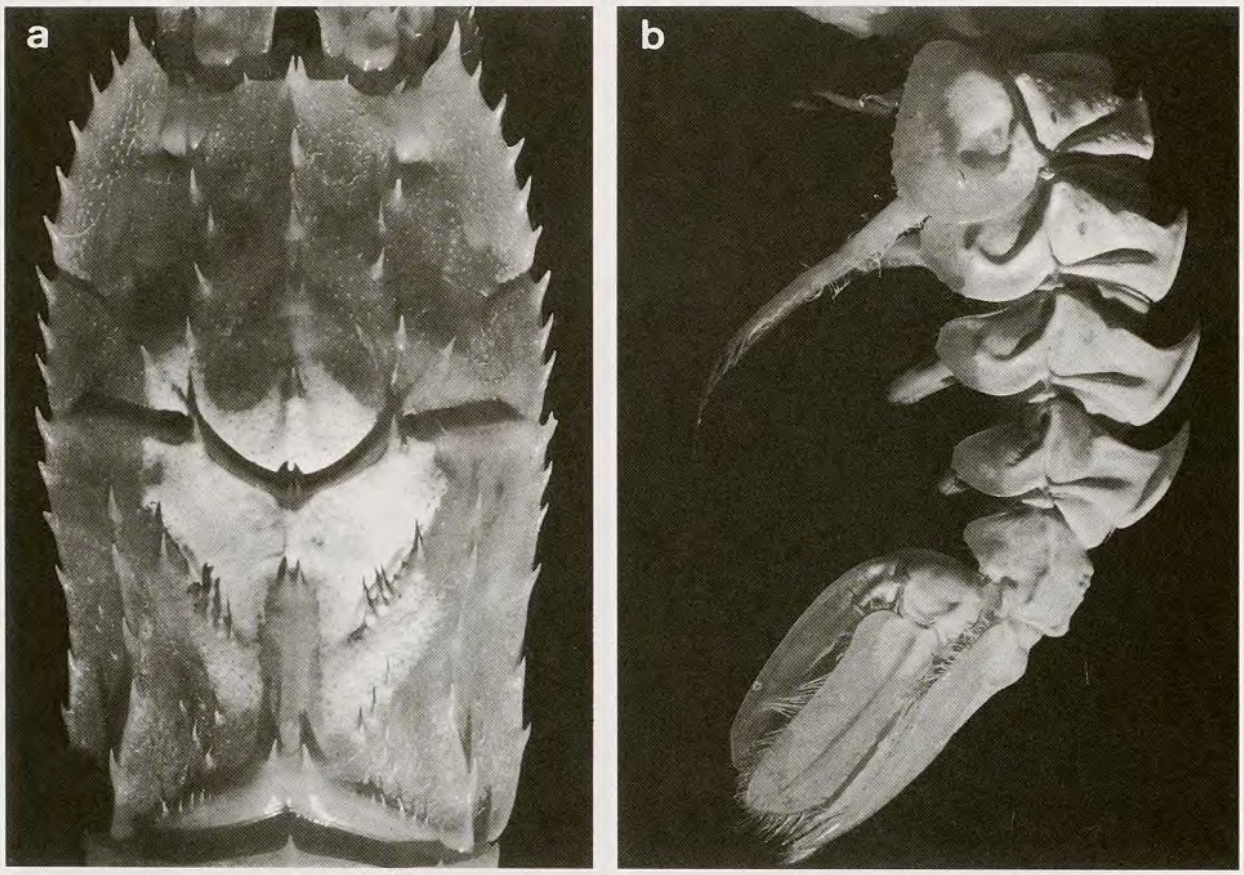

FIG. 17. — *Polycheles evexus* sp. nov. ♀ 22.8 m, Peru, *"Anton Bruun"*, stn 766, 4°10'S, 81°27'W, 1860-1815 m (USNM): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

DESCRIPTION. — Dorsal surface of carapace setose. Anterior margin straight, rostrum bifid. Internal angle of orbital sinus with slender spine, external angle unarmed. Eyestalk bearing small spine, curved distad. Basal antennular segment produced anteriorly to a sharp point, mesial margin smooth, anterolateral margin bispinose, posterior spine half as long as anterior. Spines on lateral margins of carapace upcurved, anteriormost largest. Lateral spine formula 5-6:3:6-7, spines further apart posteriorly. Spine formula of median postrostral carina 1:1:2:1; postcervical carina with two pairs of spines. Gastro-orbital region with crescentic row of five prominent antrorse spines. Posterior margin of cervical groove with antrorse spine between median and branchial carinae. Branchial carina prominent, subparallel to lateral margin, with five spines. Posterior margin of branchial groove spinose; several antrorse spines posterior to groove. Posterior margin of carapace spinose, submedian spines largest.

Abdominal tergites medially carinate. Carinae on tergites 1-5 bearing antrorse spine; spine of tergites 3-5 prominent; sixth tergite bearing mesially pair of obsoletely granulate carinae, joined posteriorly in a low tubercle. First tergite bearing two pairs of spinules distally on anterior margin. Tergites 2-5 with transversely oblique submedian grooves. Pleura 2-4 with curved rib mesially, margins minutely granulate. Second pleuron ovate. Telson with obsolescent median crest anteriorly, two convergent carinae posteriorly.

Source: MNHN, Paris

Merus of P1 proximally unispinose, subterminal claw-like spine on upper margin, finely granulose on lower margin; carpus half as long as merus with subterminal spines on upper and lower margins; upper margin of propodus with subterminal spine. P5 subchelate in male, chelate in female.

ETYMOLOGY. — The Latin *evexus* (= rounded at the top) refers to the blunter, less prominent tubercles on the sixth abdominal tergite and telson.

REMARKS. — FAXON (1895: 121) correctly observed that his Pacific specimens "differ slightly, but constantly, from the type specimens from the Atlantic. The edges of the sulcated carina on the sixth abdominal somite are less prominently denticulated and the tubercle at the posterior end of this carina is lower. Further, the spine near the base of the dorsal surface of the telson of the type specimens is reduced to a blunt tubercle in the Pacific examples." However, he failed to recognize them as a distinct species.

DISTRIBUTION. — Eastern Pacific, Mexico, Peru, Chile; 1544 m (WICKSTEN, 1989) - 2418 m (FAXON, 1895).

Polycheles helleri Bate, 1878

Fig. 18

Polycheles helleri Bate, 1878a: 277 (p.p.); 1878b: 484 (p.p.); 1878c: 563 (p.p.); 1888: 138, pl. 14 fig. 2 (p.p.). — PAGENSTECHER, 1879: 63. — SUND, 1920: 224. — HUTTON, 1904: 253.
Stereomastis helleri - DE MAN, 1916: 4 (list). — BERNARD, 1953: 87. — FIRTH & PEQUEGNAT, 1971: 65. — GRIFFIN & STODDART, 1995: 245. — DAWSON, 1997: 18.
Stereomastis nana - BABA, 1986: 157 [not Smith, 1884].

MATERIAL EXAMINED. — **Japan**. *"Albatross"*: stn 4957, Kagoshima Gulf, 32°36'N, 132°23'E, 787 m, 23.08.1905: 1 ♂ 23.2 mm (USNM). — Stn 4958, Kagoshima Gulf, 32°32'N, 132°25'E, 1296 m, 23.08.1905: 1 ♂ 20.2 mm (USNM). — Stn 4969, Wakayama, 33°23'40"N, 135°33'E, 1057 m, 29.08.1905: 3 ♂ 19.1-24.3 mm; 1 ♀ 24.9 mm (USNM). — Stn 4971, Wakayama, 33°23'30"N, 135°34'E, 1168 m, 30.08.1905: 1 ♂ 23.5 mm; 1 ♀ 28.2 mm; 4 juvs (USNM). — Stn 4972, Wakayama, 33°25'45"N, 135°33'E, 792 m, 30.08.1905: 1 ♂ 21.5 mm; 1 ♀ 35.9 mm (USNM). — Stn 4973, Wakayama, 33°24'15"N, 135°30'30"E, 1080 m, 30.08.1905: 2 ♂ 28.2, 31.2 mm; 2 ♀ 29.5, 42.5 mm (USNM). — Stn 4975, Wakayama, 33°21'30"N, 135°38'50"E, 1282-981 m, 31.08.1905: 1 ♂ 22.5 mm (USNM). — Stn 4976, Wakayama, 33°22'50"N, 135°38'30"E, 981 m, 31.08.1905: 1 ♂ 22.6 mm (USNM). — Stn 4977, Wakayama, 33°23'N, 135°37'40"E, 979 m, 31.08.1905: 1 ♀ 18.5 mm (USNM). — Stn 5082, 34°05'N, 137°59'E, 1192 m, 20.10.1905: 1 ♂ 28.3 mm; 1 ♀ 34.8 mm; 1 ov. ♀ 45.6 mm (USNM).

NE Honshu I., Iwate Pref., 39°10.3'N, 142°25'E, 980-1000 m, 19.09.1979, det. K. BABA as *Stereomastis nana*: 1 ♀ 41.3 mm (NFU 530-2-1498).

Locality uncertain, 1000 m, 26.01.1975, coll. TORIYAMA, det. K. BABA as *Stereomastis nana*: 1 ♀ 40.5 mm ((NFU 530-2-1497).

Indonesia.*"Albatross"*: stn 5601, Sulawesi, 1°13'10"N, 125°17'05"E, 1399 m, 13.11.1909: 1 ov. ♀ 35.4 mm (USNM).

New Guinea. *"Challenger"*: stn 218, 2°33'S, 144°04'E, 1957 m, 1.03.1875: 1 ♂ 20.8 mm damaged (NHM 1888.22).

New Caledonia. BIOGEOCAL: stn CP 260, 21°00.00'S, 166°58.34'E, 1820-1980 m, 17.04.1987: 2 ♀ 24.0 mm; 1 damaged (MNHN-Pa 1749).

Australia. Coral Sea. *"Franklin"*: 11°33.02'S, 145°19.34'E, 1611-1584 m, 22.08.1988, id. H.E. STODDART as *Stereomastis helleri*: 1 ♂ 18.7 mm (AM P40360).

Madagascar. *"Vauban"*: stn CH 126, 17°50'S, 43°07'E, 1475-1530 m, 16.01.1975: 1 ♂ 27.9 mm (MNHN-Pa 1559). — Stn CH 127, 17°50'S, 43°07'E, 1715-1750 m, 16.01.1975: 1 ♀ 36.7 mm (MNHN-Pa 1560). — Stn CH 131, 13°46'S, 47°33'E, 1490-1600 m, 20.01.1975: 1 ♂, 22.8 mm; 1 juv. (MNHN-Pa 1561). — Stn CH 132, 13°43.8'S, 47°29'E, 1950-2150 m, 20.01.1975: 1 ♂ 25.7 mm (MNHN-Pa 1562).

TYPE. — The male (20.8 mm cl) (NHM 1888.22) collected by the *"Challenger"* north of New Guinea is the holotype.

DESCRIPTION. — Lateral margins of carapace subparallel, convergent anteriorly. Dorsal surface of carapace sparsely setose, minutely granulate. Anterior margin of carapace straight, bearing bifid rostrum. Internal, external

Source : MNHN, Paris

angles of orbital sinus unarmed. Eyestalk with mammilate spine curved distad. Basal antennular segment with smooth mesial margin, bispinose antero-external angle. Spine formula of lateral margins of carapace 6:3:8-9, spines diminish in size posteriorly to form indistinct serrulation. Spine formula of median postrostral carina 1:1:2:1; postcervical carina with two paired spines. Posterior margin of cervical groove with spine midway between median and branchial carinae. Gastro-orbital region bearing five spines; anterior and posterior spines largest. Branchial carina sinuous, well defined, prominently spinose; posteriormost spine largest. Posterior margin of carapace bearing submedian spines.

Abdominal tergites without oblique submedian grooves, medially carinate; carinae on tergites 2-5 bearing antrorse spine, increasing in size posteriorly; fifth carina noticably larger; margins of double carina on sixth tergite smooth, confluent posteriorly. Anterior margin of first tergite with pair of lateral spinules. Pleura 3-5 with obsolescent rib mesially; second pleuron anteriorly ovate, medially faintly depressed, sparsely denticulate. Telson with two smooth, confluent carinae posteriorly.

Merus of P1 bispinose proximally on upper margin, lower margin smooth; carpus, half as long as merus, distally with claw-like spine on upper and lower margins; upper margin of propodus smooth except for subterminal spine, lower margin with single row of minute granules distally. P5 subchelate in male, chelate in female.

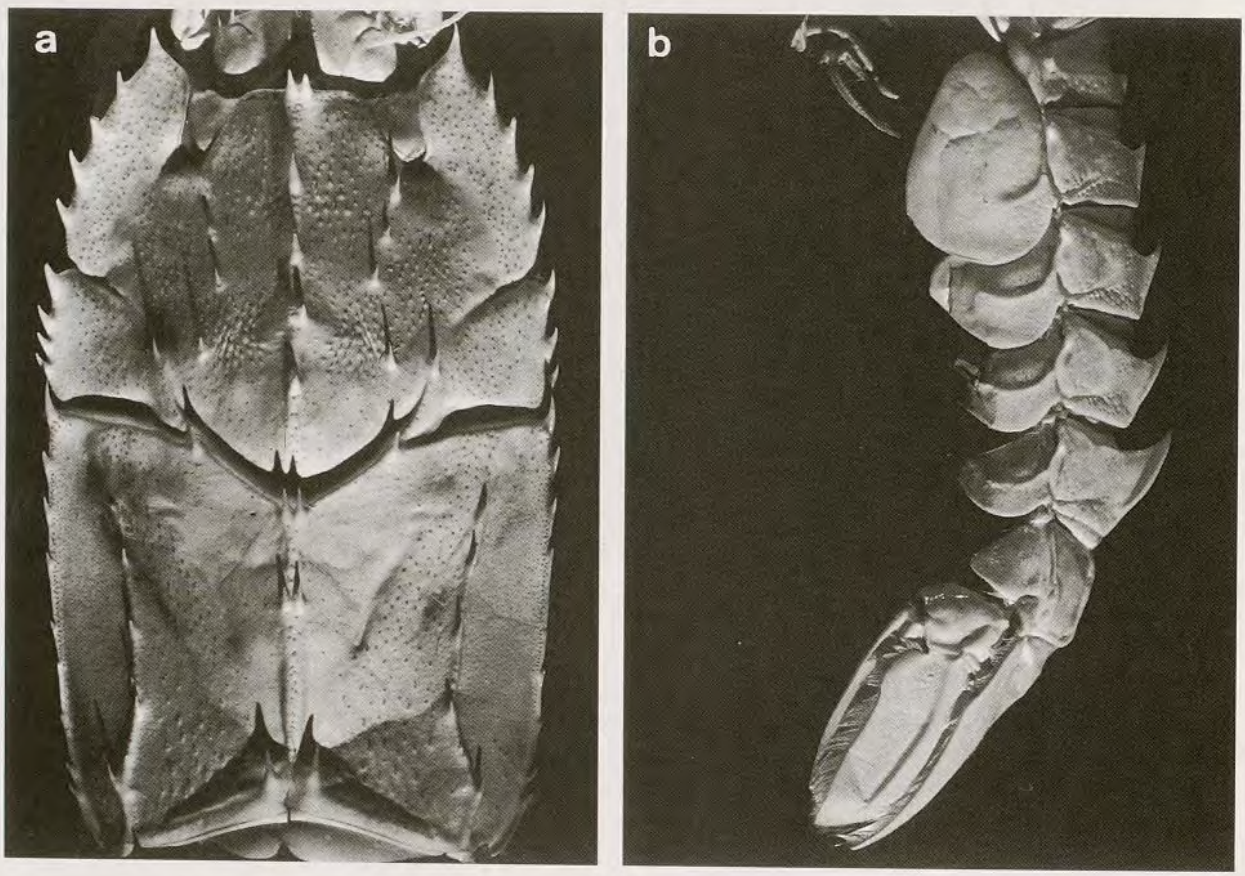

FIG. 18. — *Polycheles helleri* Bate, 1878, ♀ 36.7 mm, Madagascar, stn 127, 17°50'S, 43°07'E, 1715-1750 m (MNHN-Pa 1560): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

REMARKS. — BATE (1888: 141) wrote "I can detect no distinction of sufficient importance to separate *Pentacheles sculptus* from *Polycheles helleri*, nor would it have taken much consideration to decide their identity had it not been for the generic character of the fifth pair of pereiopoda, and that the specimens were procured from localities so widely apart". He was mistaken in all three points: *P. helleri* is easily distinguished from *sculptus* in lacking a spine on the internal orbital margin; both *helleri* and *sculptus* have the fifth the pereiopod subchelate in

Source : MNHN, Paris

the male, chelate in the female - BATE was mistaken because he examined immature specimens; and lastly, both *sculptus* and *helleri* are present in the Indo-Pacific Ocean.

GRIFFIN & STODDART (1995: 246) thought *helleri* "very similar to *S. nana* (Smith, 1884)... especially in the absence of a spine on the inner orbital angle". However, *P. nanus* bears a spine on the inner orbital angle, though it was ommited by SMITH (1884), and is further distinguished by possesing a prominent spine anteriorly on branchial groove, and having the carapace spinulose between the median postcervical and branchial carinae.

DISTRIBUTION. — Japan, New Caledonia, Australia, New Guinea, Indonesia, Madagascar; 787-2150 m.

Polycheles nanus (Smith, 1884)

Fig. 19

Pentacheles nanus Smith, 1884: 359; 1886a: 188; 1886b: 607, 612, 619, 651, pl. 7 figs 1, 1a. — VERRILL, 1885: 554. — FOWLER, 1912: 569.
Pentacheles andamanensis Alcock, 1894: 239. — ALCOCK & ANDERSON, 1895 pl. 10 fig. 3.
Polycheles nanus - CAULLERY, 1896: 386, pl. 16 fig. 12. — KOEHLER, 1896: 723. — BOUVIER, 1905a: 480; 1905c: 5; 1915: 2; 1917: 35. — HANSEN, 1908: 42. — STEBBING, 1908: 27; 1910: 377. — MURRAY & HJORT, 1912: 539. — STEPHENSEN, 1912: 578; 1913: 11. — SELBIE, 1914: 21. — SUND, 1915: 372. — WILLIAMSON, 1915: 457. — JENSEN, 1928: 24. — MIRANDA & RIVERA, 1933: 17. — HEEGAARD, 1941: 20, fig. 6. — LE DANOIS, 1948: 255. — KRAMP, 1963: 57. — ALLEN, 1967: 55. — THIRIOT, 1974: 344 (list).
Polycheles andamanensis - ALCOCK, 1899: 33; 1901b: 169. — BOUVIER, 1905a: 481; 1905c: 5; 1917: 35. — RAMADAN, 1938: 124. — SEWELL, 1955: 205. — DONG *et al.*, 1986: 203.
Polycheles grimaldii Bouvier, 1905a: 481; 1905c: 4; 1917: 52, pl. 3 figs 2-4. — BOAS, 1939: 4, pls 2,4,5,6,9. — DANOIS, 1948: 255.
Polycheles nanus var. *grimaldii* - SELBIE, 1914: 21, pl. 1 figs 14-15. — RICHARD, 1907: 322.
Stereomastis nana - DE MAN, 1916: 4 (list). — CALMAN, 1925: 19. — BARNARD, 1950: 573, fig. 105e. — BERNARD, 1953: 87. — DAHL, 1953: 46. — KENSLEY, 1968: 293; 1981b: 29. — FIRTH & PEQUEGNAT, 1971: 65. — BAEZ & ANDRADE, 1979: 226. — WENNER, 1979: 436. — WENNER & BOESCH, 1979: 131. — GEORGE, 1983: 16. — DE SAINT LAURENT, 1985: 474. — SQUIRES, 1991: 354 (key). — TAKEDA & HANAMURA, 1994: 32. — DAWSON, 1997: 19.
Stereomastis grimaldii - DE MAN, 1916: 4 (list). — STEPHENSEN, 1923: 67. — ZARIQUIEY, 1968: 211. — BEAUBRUN, 1979: 42, figs 22-23. — MACPHERSON, 1991: 405, fig. 7.
Stereomastis nanus - STEBBING, 1917: 30. — ABELE & FELGENHAUER, 1982: 311 [non Smith, 1884].
Stereomastis grimaldii - THIRIOT, 1974: 344 (list).
Stereomastis andamanesis - OHTA, 1983: 230 (list) [erroneus spelling] [non Alcock, 1895].
Stereomastis andamanensis - DE MAN, 1916: 16, pl.1 figs 2, 2b (p.p.). — DAHL, 1953: 46. — HOLTHUIS, 1984: 4. — GRIFFIN & STODDART, 1995: 244 (p.p.). — DAWSON, 1997: 17 (p.p.) [non Alcock, 1895].
not *Polycheles nanus* - FAXON, 1895: 121, pl. 33 figs 1, 1a-b [= *P. evexus* sp. nov.].
not *Polycheles grimaldi* - WOLFF, 1967: 236 (photo) [= *P. talismani* (Bouvier, 1917)].
not *Stereomastis nana* - MIYAKE, 1982: 78, pl. 26 fig. 6 [= *P. typhlops* Heller, 1862].
not *Stereomastis nana* - BABA *et al.*, 1986: 284 [= *P. helleri* Bate, 1878].
not *Stereomastis nana* - BABA *et al.*, 1986, pl. 109 [= *P. enthrix* (Bate, 1878)].
not *Stereomastis nana* - WICKSTEN, 1989: 304 [= *P. evexus* sp. nov.].
not *Stereomastis nana* - HENDRICKX, 1995: 156 [= *P. evexus* sp. nov.].

MATERIAL EXAMINED. — **Bay of Biscay**. *"Thalassa"*: stn 333, 44°10.5'N, 4°32.'W, 1900-1950 m, 14.10.1971: 1 juv. (MNHN-Pa 346). — Stn 453, 48°34'N, 10°51.6'W, 1975-2070 m: 1 ♂ 20.8 mm; 2 ♀ 21.9, 19.4 mm (MNHN-Pa 352).

BIOGAS IV: stn CV 33, 44°04.6'N, 4°18.1'W, 1913 m, Feb. 1974: 3 ♀ 25.7-26.3 mm (MNHN-Pa 644).

BIOGAS XI, CP 37: stn 1, 47°33.80'N, 8°40.5'W, 2175 m, 11.10.1981, coll. IFREMER: 1 ♀ damaged (MNHN-Pa 1138).

Western Sahara. *"Meteor"*: stn M36-100 AT 152, 21°27.1'N, 18°16.1'W, 2049-2110 m, 26.02.1975: 2 spec. (SMF 24646).

West Africa. *Senegal. "Talisman"*: stn 98, 17°16'N, 20°17'W, 2324 m, 17.07.1883: 1 ♂ damaged (MNHN-Pa 22). — Stn 100, 17°16'N, 19°19'W, 1550 m, 17.07.1883: 1 ♀ 35.1 mm (MNHN-Pa 21).

Ivory Coast."Pillsbury": stn 233, 5°19'N, 4°14'E, 2013-1464 m, 12.05.1965: 1 ♀ 49.4 mm (RMNH).

Azores. *"Talisman"*: stn 698, 39°11'N, 33°04'W, 1846 m, 18.07.1883: 1 ♂ 18.6 mm (MNHN-Pa 23). — Stn 863, 39°19'N, 29°15'W, 1940 m, 1.08.1897: 1 ♀ 21.7 mm (MNHN-Pa 24).

Source : MNHN, Paris

CANCAP 5: stn 5.016, 37°21'N, 25°29'W, 2000-2100 m, 26.05.1981: 5 ♂ 19.5-20.7 mm; 4 ♀ 19.8-20.0 mm (RMNH). — Stn 5.123, 38°56'N, 27°44'W, 2300-2400 m, 4.06.1981: 1 ♂ 29.8 mm (RMNH). — Stn 5.162, 39°21'N, 30°51'W, 900 m, 11.06.1981: 1 juv. (RMNH).

"Atlantis": cr. 152, stn 20, 37°50.5'N, 26°00'W, 2560 m, 18.08.1948, coll. L.W. HUTCHINS, id. F.A. CHACE as *P. grimaldii*: 1 ♂ 22.0 mm (USNM 88693).

SE Atlantic. *Off Cape Province. "Africana"*: 32°26'S, 16°11'E, 1302 m, 27.01.1993: 2 ov. ♀ 26.1, 27.1 mm (SAM). — 32°22'S, 16°09'E, 1150 m, 14.01.1995: 3 ♀ 23.2-27.7 mm (SAM).

Canada. *"Albatross"*: stn 2706, Nova Scotia, 41°28'05"N, 65°35'05"W, 2138 m, 27.08.1886: 2 ♂ 17.7, 23.1 mm; 3 ♀ 19.1-22.7 mm (USNM 11887).

United States. *"Albatross":* stn 2102, 38°44'N, 72°38'W, 2212 m, 5.11.1883: 1 ♂ 22.8 mm (USNM 5714). — Stn 2035, 39°26'12"N, 70°02'37"W, 2490 m, 17.07.1883: 1 ♀ damaged (USNM 7142). — Stn 2077, 41°09'40"N, 66°02'W, 2296 m, 4.09.1883: 3 ♂ 19.0-22.3 mm (USNM 7143). — Stn 2102, 38°44'N, 72°38'W, 2212 m, 5.11.1883: 1 ♂ 22.6 mm; 1 ♀ 22.5 mm (USNM 5714). — Stn 2103, 38°47'20"N, 72°37'00"W, 1964 m, 5.11.1883: 2 juvs (AMNH 15329). — Stn 2105, 37°50'N, 73°03'50"W, 2551 m, 6.11.1883: 1 ♀ 18.7 mm (USNM 5711). — Stn 2106, 37°41'20"N, 73°03'20"W, 2838 m, 6.11.1883: 1 ♀ 19.0 mm (USNM 5710). — Stn 2115, 35°49'30"N, 74°34'45"W, 1541 m, 11.11.1883: 1 ♂ 20.4 mm; 1 ♀ 19.5 mm (USNM 5709). — Stn 2116, 35°45'23"N, 74°31'25"W, 1624 m, 11.11.1883: 3 ♀ 19.0-35.6 mm (USNM 5708). — Stn 2205, 39°35'00"N, 71°18'45"W, 1931 m, 20.08.1884: 2 ov. ♀ 27.8, 27.6 mm (AMNH 15239); 2 ♀ 23.5, 26.7 mm (USNM 8237). — Stn 2206, off New Jersey, 39°35'00"N, 71°24'30"W, 1877 m, 20.08.1884: 1 ov. ♀ 29.5 mm; 1 juv. (USNM 8238). — Stn 2230, 38°27'00"N, 73°02'00"W, 2102 m, 12.09.1884: 1 ♀ 23.2 mm (AMNH 15589). — Stn 2533, 40°16'30"N, 67°26'15"W, 1490 m, 15.07.1885: 1 ov. ♀ 31.3 mm (AMNH 15176). — Stn 2728, 36°30'N, 74°33'W, 1546 m, 25.10.1886: 1 ov. ♀ 31.8 mm (AMNH 15104). — Stn 2729, 36°36'N, 74°32'W, 1222 m, 25.10.1886: 1 ♀ 22.1 mm (AMNH 15104). — Stn 2731, 36°45'N, 74°28'W, 1406 m, 25.10.1886: 1 ov. ♀ 32.3 mm (USNM 12270). — Stn 2732, 37°27'N, 73°33'W, 2074 m, 26.10.1886: 1 ov. ♀ 27.3 mm (USNM 12274). — Stn 2734, 37°23'N, 74°33'W, 1514 m, 26.10.1886: 1 ov. ♀ 29.7 mm (AMNH 15106).

"Gilliss": stn 71, 36°37.36'N, 74°28'W, 1695-1734 m, 17.11.1974: 1 ♂ 29.6; 1 ♀ damaged (USNM 314136). — Stn 72, 36°36.18'N, 74°24.48'W, 1730-1790 m, 17.11.1974: 1 ♂ 27.9 mm (USNM 314136). — Stn 84, 36°36'N, 74°24.24'W, 1740-1775 m, 19.11.1974: 1 ♂ 18.1 mm (USNM 314136). — Stn 95, 37°05'N, 74°12.30'W, 2250 m, 22.11.1974: 1 ♂ 20.7 mm (USNM 314136). — Stn 97, 37°00.18'N, 74°15'W, 1400-1460 m, 23.11.1974: 2 ♂ 19.0, 20.4 mm; 3 ♀ 19.1-26.9 mm; 2 ov. ♀ 26.1, 30.6 mm (USNM 314136).

Wallis & Futuna Is area. — MUSORSTOM 7. *SW of Combe Bank*: stn CP 621, 12°34.4'S, 178°11.5'W, 1280 m, 28.05.1992: 1 ♀ 27.0 mm (MNHN-Pa 1712).

Vanuatu. MUSORSTOM 8: stn CP 1124, 15°01.72'S, 166°56.51'E, 532-599 m, 9.10.1994: 1 ♀ 43.7 mm (MNHN-Pa 1565). — Stn CP 1125, 15°57.63'S, 166°38.43'E, 1160-1220 m, 10.10.1994: 1 ♂ 22.8 mm; 1 juv. (MNHN-Pa 1566). — Stn CP 1126, 15°58.35'S, 166°39.98'E, 1210-1260 m, 10.10.1994: 1 ♀ 30.2 mm (MNHN-Pa 1567). — Stn CP 1127, 15°58.86'S, 166°37.82'E, 1052-1058 m, 10.10.1994: 1 ♀ 32.3 mm (MNHN-Pa 1568).

New Caledonia. BIOCAL: stn CP 30, 23°09'S, 166°41'E, 1140 m, 29.08.1985: 1 ♀ 36.2 mm (MNHN-Pa 1569).

BIOGEOCAL: stn CP 205, 22°40.61'S, 166°28.01'E, 1350-1380 m, 8.04.1987: 1 juv. (MNHN-Pa 1713).

HALIPRO 1: stn CP 858, 21°42'S, 166°41'E, 1000-1120 m, 20.03.1994: 1 ♀ (MNHN-Pa 1570).

BATHUS 1: stn CP 651, 21°41.8'S, 166°40.1'E, 1080-1180 m, 11.03.1993: 1 ♂ 25.1 mm (MNHN-Pa 1678).

HALIPRO 2: stn BT 95, 24°00'S, 162°08'E, 1224-1233 m, 25.11.1996: 1 ♂ 22.4 mm; 1 ♀ 29.7 mm (MNHN-Pa 1699). — Stn BT 103, 24°54'S, 162°09'E, 1235-1256 m, 26.11.1996: 1 ♀ 41.3 mm (MNHN-Pa 1700). — Stn BT 105, 25°45'S, 162°50'E, 1200-1218 m, 27.11.1996: 1 ♀ 32.4 mm (MNHN-Pa 1701). — Stn BT 106, 25°27'S, 163°16'E, 1315-1357 m, 27.11.1996: 2 ♀ 25.2, 23.8 mm (MNHN-Pa 1702).

Chesterfield Islands. MUSORSTOM 5: stn 323, 21°18.52'S, 157°57.62'E, 970 m, 14.10.1986: 1 ♀ 21.9 mm (MNHN-Pa 1571). — Stn 324, 21°15.01'S, 157°51.33'E, 970 m, 14.10.1986: 1 ♀ 22.7 mm (MNHN-Pa 1572).

New Zealand. NZOI. stn U 198, 34°59.3'S, 162°11.21'E, 1573 m, 26.09.1982: 1 juv. (NIWA).

Australia. Lord Howe Rise. *"Franklin"*: 27°59.3'S, 162°48.6'E, 1250 m, 6.05.1989, id. H.E. STODDART as *Stereomastis andamanensis*: 1 ♀ 42.6 mm (AM P40370).

Japan. *"Albatross"*: stn 4909, Kagoshima Gulf, Koshiki Is, 31°38'30"N, 129°27'30"E, 540 m, 11.08.1906: 1 ♀ 24.0 mm (USNM).

East China Sea. *"Ryoan Maru"*: 29°11'N, 127°11'E, 300-310 m, 17.03.1978, det. Y. MIYA as *Stereomastis andamanensis*: 2 ♀ 20.6, 34.9 mm (NUM cr10238).

Philippines. *"Albatross"*: stn 5468, Lagonoy Gulf, San Bernardino Str., 13°35'30"N, 123°40'28"E, 1024 m, 18.06.1909: 1 ♀ 32.7 mm (USNM).

Indonesia. *"Siboga":* stn 48, 8°47'S, 188°44.3'E, 2000 m, 13.04.1899: 1 juv. (ZMA).

CORINDON: stn CH 241, 0°58'S, 119°15'E, 1525-1550 m: 1 juv. (MNHN). — Stn CH 286, 2°03'S, 118°45'E, 1710-1730 m: 3 juvs (MNHN-Pa 1573).

Arabian Sea. *"Investigator"*: stn 108, off Cape Comorin, 7°04'N, 76°34'15"E, 1877 m; 24.10.1890: 1 ♀ 20.5 mm (IM 532/7). — Stn 250, SW Ceylon, 6°54'30"N, 79°34'30"E, 878 m, 20.10.1898, det. ALCOCK as *P. andamanensis*: 1 ♀ 31.0 mm; 3 juvs (IM 3421/10).

Source: MNHN, Paris

Gulf of Aden. *"Meteor 5"*: stn Me5-257, 13°06.6'N, 47°54.0'E, 2227-2250 m, 11.03.1987: 2 ♂ 19.6, 21.8 mm (SMF 24653). — Stn 262, 13°19.7'N, 47°29.2'E, 1830-1837 m, 12.03.1987: 1 ♂ 22.0 mm (SMF 24652).

TYPES. — The male (22.8 m cl) (USNM 5714) collected by the *"Albatross"* at stn 2102 (38°44'N, 72°38'W, 2212 m) is designated here as the lectotype of *P. nanus* Smith, 1884.

The female (20.5 mm cl) (IM 532/7) collected by the *"Investigator"* stn 108, off Cape Comorin (7°04'N, 76°34'15"E, 1908 m) is the holotype of *Pentacheles andamanensis* Alcock, 1894.

The female (35.1 mm cl) (MNHN PA21) collected by the *"Talisman"* off Senegal is the holotype of *P. grimaldii* Bouvier, 1905.

DESCRIPTION. — Dorsal surface of carapace setose. Anterior margin straight, rostrum bifid. Internal angle of orbital sinus with slender spine, external angle unarmed. Eyestalk bearing small spine, curved distad. Basal antennular segment produced anteriorly to a sharp point, mesial margin smooth, anterolateral margin bispinose, posterior spine half as long as anterior. Spines on lateral margins of carapace upcurved, anteriormost largest. Lateral spine formula 5-6:3:6-7, spines further apart posteriorly. Spine formula of median postrostral carina 1:1:2:1 anterior to cervical groove, postcervical carina with two pairs of spines. Gastro-orbital region with crescentic row of five prominent antrorse spines. Posterior margin of cervical groove with antrorse spine between median and branchial carinae. Branchial carina prominent, subparallel to lateral margin, with five spines. Carapace between branchial and median carinae unarmed anteriorly, obliquely grooved medially, spinulose posteriorly. Large spine distally on posterior margin of oblique groove. Posterior margin of carapace spinose, submedian spines largest. First abdominal tergite bearing two pairs of spines distally on anterior margin.

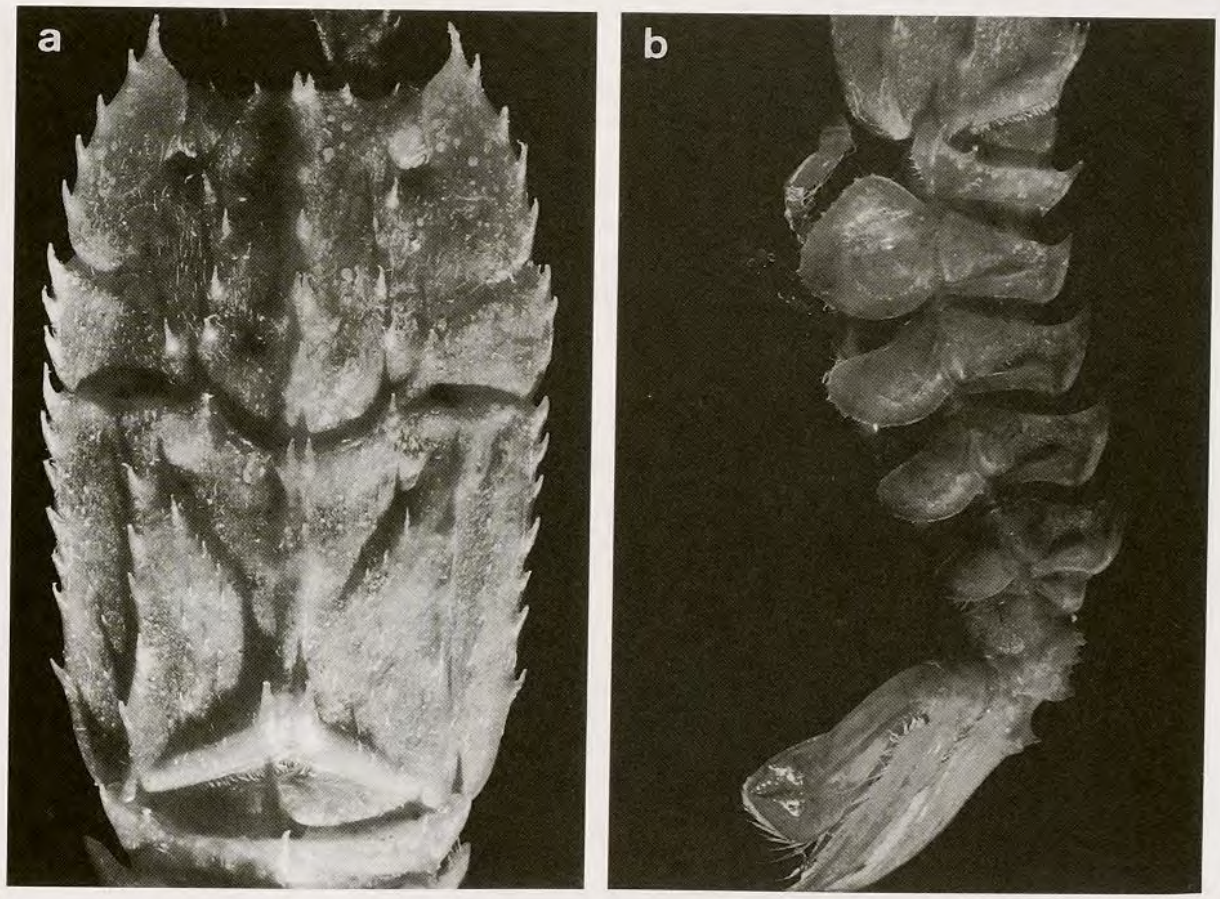

FIG. 19. — *Polycheles nanus* (Smith, 1884), ♀ 26.1 mm, Off Cape Province, *"Africana"*, 32°26'S, 16°11'E, 1302 m (SAM): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

Source : MNHN, Paris

Abdominal tergites medially carinate. Carinae on tergites 1-5 bearing antrorse spine; spine of tergites 3-5 longer, salient; sixth tergite bearing mesially pair of denticulate carinae, joined posteriorly in a prominent tooth. Tergites 2-5 with transversely oblique submedian grooves. Pleura 2-4 with curved rib mesially, margins minutely granulate. Second pleuron ovate. Telson with denticulate median crest anteriorly, two minutely serrulate, convergent carinae posteriorly.

Merus of P1 proximally bispinose with subterminal claw-like spine on upper margin, finely granulose on lower margin; carpus half as long as merus, subterminal spines on upper and lower margins; upper margin of propodus with subterminal spine, lower margin with two minutely granulate rows distally. P5 subchelate in male, chelate in female.

Color. — BOUVIER (1917: 54) wrote "D'après deux aquarelles ..... l'animal est rouge avec une teinte d'un blanc jaunâtre sur le céphalothorax". But he adds "il est probable que cette teinte (blanc jaunâtre) est due à la vase".

REMARKS. — *P. nanus* is distinguished from *P. sculptus* in having the region between the branchial and median carinae spinulose posteriorly, and having a prominent spine anteriorly on the branchial groove.

SMITH (1884: 359) described *P. nanus* : "the surface of the branchial region on both sides of the sublateral carina is armed with many small spines or spinules, and on the anterior part of the oblique ridge between the dorsal and sublateral carinae there is one spine as large as the spines of the sublateral carina itself", and added "the distinctive characters are well marked and very constant in all the large number of specimens seen". Yet he hesitated: "This species is very closely allied to *P. sculptus* and will possibly prove to be only a dwarf deep-water variety of it". FAXON (1895: 121) reiterated: "*P. nanus* may be only a dwarf deep-water variety of *P. sculptus*". HANSEN (1908: 42), who examined the large series of specimens collected by the *"Ingolf"* expedition, disagreed : "*P. nanus* must remain an independent species well-marked off from *P. sculptus*". Yet, KENSLEY (1968: 294) persisted: "The possibility exists that *nana* is a juvenile form of *sculpta* and that some of the spines are lost with development". However, the distinguishing characters separating *P. sculptus* and *P. nanus* were found to be constant in the many specimens studied; this, together with the comparable vertical distributions of both species, and the ovigerous *nanus* specimens found, convince us that *sculptus* and *nanus* are indeed distinct species.

SMITH's (1884) omission of the spine on the interior margin of the orbital sinus (though the type specimens possess them) moved BOUVIER (1905a) to describe *P. grimaldii*. BOUVIER (1905c: 4) gallantly complimented the type specimen on being "une très jolie femelle" and pronounced "j'ai pu constater que le *Polycheles grimaldii* est une forme représentative... d'une espèce américaine décrite et figurée par Smith, le *P. nanus*". Indeed, SELBIE (1914: 2) regarded *grimaldii* as "merely... a variety" of *P. nanus*, and CALMAN (1925: 19) surmised it "may even be identical with the typical form of that species".

DE MAN (1916: 20) recognized the similarity between *andamanensis* and *nanus*: "This species [*andamanensis*] now bears such a close resemblance to *Stereom. nana* (S.I. Smith), that I wonder why Col. Alcock has made no mention of it". Yet the specimens DE MAN described as *andamanensis* are in fact *P. phosphorus*.

DISTRIBUTION. — Worldwide: Iceland, Irish Sea, Bay of Biscay, Portugal, West Africa, Azores, South Africa, Mid Atlantic Bight, Greenland, Canada, United States, Wallis & Futuna Is area, Vanuatu, New Caledonia, New Zealand, Australia, Japan, East China Sea, Philippines, Indonesia, India, Arabian Sea, Gulf of Aden; 300 m (present work) - 4000 m (STEPHENSEN, 1923).

Polycheles pacificus (Faxon, 1893)

Fig. 20

Polycheles sculptus pacificus Faxon, 1893: 196; 1895: 122, pl. 50 figs 1, 1a. — CAULLERY, 1896: 386. — HANSEN, 1908: 42. — MURRAY & HJORT, 1912: 587, fig. 427. — BOUVIER, 1915: 2. — SUND, 1915: 372. — LUKE, 1977: 20. — PRETZMANN, 1983: 316.

Stereomastis sculpta pacifica - DE MAN, 1916: 5 (list). — FIRTH & PEQUEGNAT, 1971: 71. — WICKSTEN, 1980: 914; 1989: 293. — WICKSTEN & MENDEZ, 1982: 110. — HENDRICKS, 1995: 156. — DAWSON, 1997: 23.

Polycheles sculptus - DEL SOLAR, 1972: 11 [non Smith, 1880].

Stereomastis pacifica - RETAMAL, 1981: 16. — QUINTANA & RETAMAL, 1984: 133.

Source : MNHN, Paris

MATERIAL EXAMINED. — **United States**. *California*. SW Pt Conception, 900-1080 m, 10.05.1979, id. M. WICKSTEN as *Stereomastis sculptus pacificus*: 1 ♂ 33.8 mm (LACM ex AHF 1679-1). — Tanner Bank, 32°52.56'N, 120°09.06'W, 1080 m, 26.10.1979, id. M. WICKSTEN as *Stereomastis sculptus pacificus*: 1 ♀ 39.7 mm (LACM ex AHF). — SW Santa Rosa I., 1080-1260 m, 18.10.1979, id. M. WICKSTEN as *Stereomastis sculptus pacificus*: 1 ♂ 32.2 mm (LACM ex AHF).

Mexico. *Baja California*. *"Albatross"*: stn 5685, 25°42'45"N, 113°38'30"W, 1161 m, 22.04.1911, 1 ♂; 1 ♀ (damaged) (AMNH A6281).

"Velero III": stn 13770, Off San Juanito I., 1125-1530 m, 21.01.1970, id. M. WICKSTEN as *Stereomastis sculptus pacificus*: 1 ♀ 39.7 mm (LACM ex AHF).

31°59.6'N, 118°47.4'W, 1110 m, 11.1978, id. M. WICKSTEN as *Stereomastis sculptus pacificus*: 1 ov. ♀ 46.9 mm (LACM ex AHF 1396-1).

Gulf of Panama. *"Galathea"*: stn 724, 5°44'N, 79°20'W, 2712-3330 m, 12.05.1952: 2 ♀ 18.9, 21.8 mm (ZMC). — Stn 739, 7°22'N, 79°32'W, 938 m, 15.05.1952: 25 ♂ 31.0-34.7 mm; 12 ov. ♀ 41.9-53.3 mm; 25 ♀ 39.0-49.6 mm (ZMC). — Stn 745, 7°15'N, 79°25'W, 938 m, 16.05.1952: 1 ♂ 33.0 mm; 1 ov. ♀ 46.3 mm; 2 ♀ 36.2, 40.6 mm (ZMC).

"Gilliss": stn 22, 7°28.5'N, 79°12'W, 741-823 m, 18.01.1972: 1 ♂ 33.9 mm; 3 ♀ 42.5-43.7 mm (RMNH).

"Albatross": stn 3394, 7°21'N, 79°35'W, 920 m, 10.03.1891: 13 ♂ 31.5-34.4 mm; 19 ♀ 37.1-48.1 mm (USNM 21076).

Ecuador. *"Anton Bruun"*: stn 770, Gulf of Guayaquil, 3°15'S, 80°55'W, 945-960 m, 10.09.1966: 3 ♂ 33.9-34.2 mm; 1 ♀ 37.1 mm (USNM).

450-500 m, 2.05.1967, coll. G. RICAUTER: 1 ov. ♀ 42.4 mm (RMNH 23445).

Peru. *"Anton Bruun"*: 7°49'S, 80°38'W, 605-735 m, 5.09.1966: 3 ♂ 31.3-34.1 mm; 3 ♀ 39.2-40.3 mm (USNM). — 7°44.05'S, 80°30.05'W, 750-760 m, 23.01.1974, id. M. WICKSTEN as *Stereomastis sculptus pacificus*: 2 ♂ 33.3, 35.4 mm;1 ♀ 40.4 mm (LACM ex AHF 104-01). — 7°46'S, 80°31'W, 800 m, 23.01.1974, id. M. WICKSTEN as *Stereomastis sculptus pacificus*: 2 ♂ 35.6, 35.4 mm (LACM ex AHF 103-05).

Chile. *"Anton Bruun"*: stn 714, 25°00'S, 70°40'W, 950 m, 16.08.1966: 3 ♂ 32.7-35.5 mm (USNM).

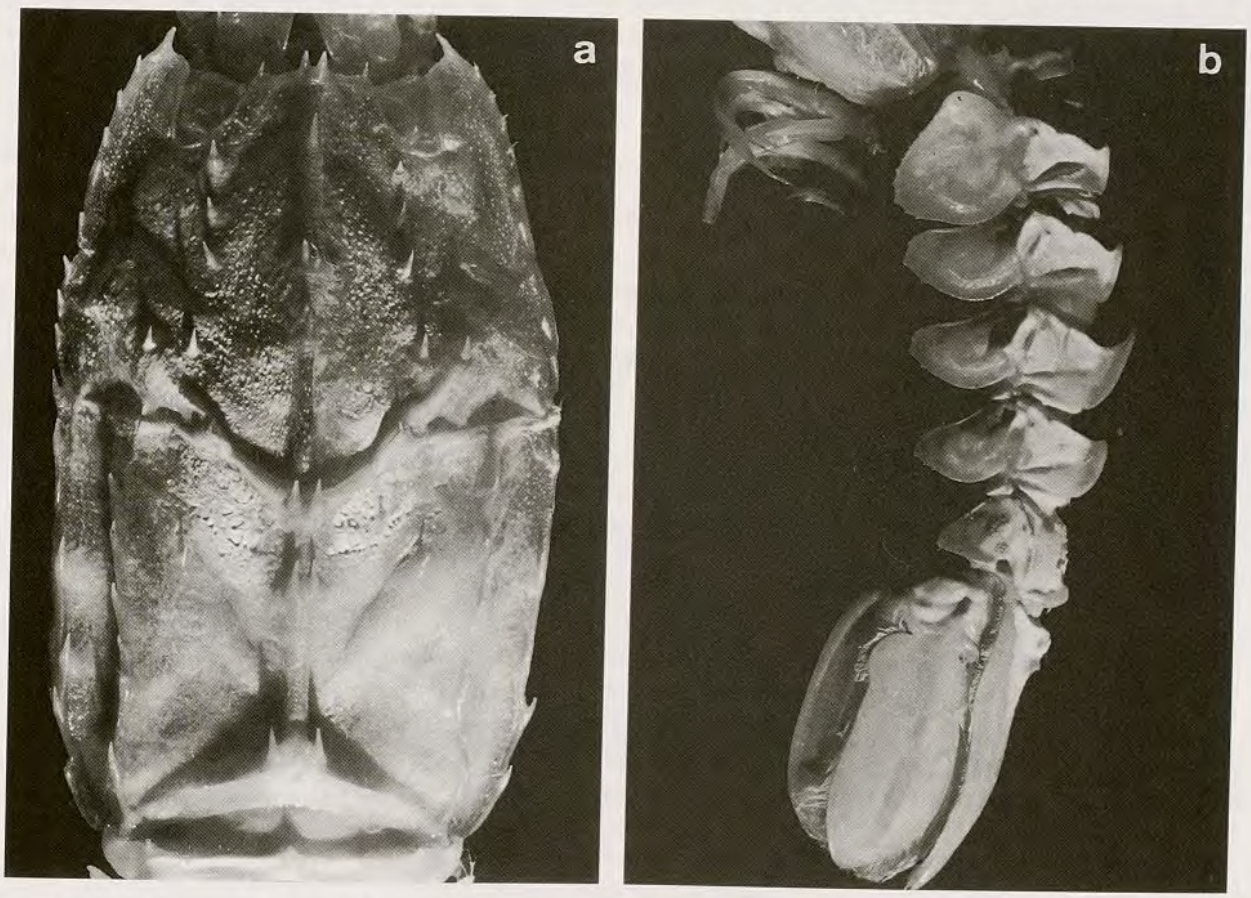

FIG. 20. — *Polycheles pacificus* (Faxon, 1893), ♂ 32.0 mm, Panama, *"Albatross"* stn 3394, 7°21'N, 79°35'W, 920 m (USNM 21076): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

Source : MNHN, Paris

TYPES. — The male (34.4 mm cl) (USNM 21076) collected by the *"Albatross"* stn 3394, off Panama (7°21'N, 79°35'W, 920 m) is the holotype. The other specimens of the sample are paratypes

DESCRIPTION. — Dorsal surface of carapace densely setose. Anterior margin of carapace nearly straight, bearing two rostral spines. Internal angle of orbital sinus spinose, external angle convex, unarmed. Eyestalk bearing distad mammilate tubercle. Basal antennular segment produced anteriorly to a sharp point, mesial margin smooth, anterolateral angle bispinose. Spine formula of lateral margin of carapace 6:3:7. Spine formula of median postrostral carina 1:2:1; postcervical carina bearing two paired spines. Gastro-orbital region with five spines. Branchial carina well-defined, bearing 5 prominent spines. Single spine midway between second spine of branchial carina and median postcervical carina. Posterior margin of carapace bearing pair of prominent submedian spines.

First abdominal tergites bearing two pairs of spines distally on anterior margin, lateral pair minute, mammilate. Median carina on tergites 1-4 bearing antrorse spine, increasing in size posteriorly. Fifth carina without antrorse spine, bulbous. Sixth tergite bearing lyre-shaped carina, posteriorly with raised knob. Shallow, transversely oblique grooves on either side of median carina 2-5. Pleura 2-5 with cresentic carina mesially; margins setose, occasionally denticulate. Second pleuron not produced anteriorly. Telson with median blunt crest anteriorly; rounded, convergent carinae posteriorly.

Merus of P1 with two spines proximally and a single subterminal claw-like spine on upper margin; minutely serrulate lower margin; carpus with subterminal claw-like spine on upper and lower margins; lower margin of propodus with two rows of spines distally, upper margin with subterminal antrorse spine. P5 subchelate in male, chelate in female.

Color. — "Pale rose purple on the dorsal side of the carapace and abdomen, deepening to a brighter orange red on the thoracic appendages, the branches of the posterior abdominal appendages, and the flagella of both pairs of antennae, and fading to a delicate bluish white on the hepatic and anterior brnachial regions. The raised ridges of the carapace and abdomen are whitish, the setae on the margins of the basal parts of antennae, swimmerets, etc., are yellow". (FAXON, 1895: 123, pl. C).

REMARKS. — FAXON (1893: 196) separated *P. sculptus pacificus* from the typical form citing the "small spine on each branchial region inside of and on a level with the second spine of the submarginal carina ... the pleurae of the second abdominal somite have a different shape... These differences, although slight, are constant". Other distinguishing characters are the mammilate lateral spine on the first abdominal tergite, the bulbous median carina on the fifth abdominal tergite and the prominent knob posteriorly on the median carina of the sixth abdominal tergite.

DISTRIBUTION. — Eastern Pacific, from California to Chile; 600 m (present work) - 3380 m (WICKSTEN, 1981).

Polycheles perarmatus Holthuis, 1952

Fig. 21

Polycheles typhlops perarmata Holthuis, 1952b: 7, figs 1-2. — BURUKOVSKY, 1983: 134, fig. 178.
Polycheles perarmatus FOREST, 1963: 627. — FRANSEN *et al.*, 1997: 61.
Polycheles typhlops - SPRINGER & BULLIS, 1956: 14 (p.p.).
Polycheles typhlops perarmatus - FIRTH & PEQUEGNAT, 1971: 56, fig. 8. — GRIFFIN & STODDART, 1995: 243. — DAWSON, 1997: 15.

MATERIAL EXAMINED. — **West Africa**. *Ivory Coast* and *Nigeria*. *"Pillsbury"*: stn 44, 5°05'N, 4°00'W, 586-403 m, 30.05.1964: 3 juvs (RMNH). — Stn 255, 3°49'N, 7°38'E, 269-264 m, 14.05.1965: 1 ♂ 40.2 mm; 2 ♀ 41.4, 49.8 mm (RMNH). — Stn 256, 3°49'N, 7°38'E, 267-264 m, 14.05.1965: 8 ♂ 48.0-54.4 mm; 2 ♀ 54.4, 51.1 mm (RMNH).

Ghana. GUINEAN TRAWLING SURVEY I: stn 28\8, 4°16'N, 2°09.30'W, 380-400 m, 4.10.1963: 1 ♂ 24.9 mm (MNHN-Pa 559).

Equatorial Guinea. *"Atlantide"*: stn 120, 2°09'N, 9°27'E, 260-650 m, 1.03.1946: 1 ♂ 19.0 mm (ZMC).

Gabon. 1°64'S, 8°44'E, 396 m, 3.09.1963, id. R.B. MANNING: 1 ♂ 37.6 mm (USNM 125986). — *"Mbizi"*: stn AS 154, 0°15'S, 8°47'E, 239 m, 15.03.1949: 2 ♀ 50.7, 45.8 mm (RMNH 8622).

Source: MNHN, Paris

Congo. *"Ombango"*: 5°34'S, 11°35'W, 345-350 m, 7.07.1967, coll. A. CROSNIER: 1 ♀ 52.2 mm (MNHN-Pa 1122). — 4°49'S, 11°17'W, 300-600 m, 30.10.1969, coll. A. CROSNIER: 1 ♂ 50.8 mm; 1 ♀ 46.2 mm (MNHN-Pa 1575).

Gulf of Mexico. *"Albatross"*: stn 2376, 29°03'03"N, 88°16'W, 583 m, 11.02.1885, id. M.J. RATHBUN as *P. agassizii*: 1 ♂ 21.2 mm; 1 ♀ 31.1 mm; 1 juv. (USNM 23470). — Stn 2377, 29°07'05"N, 88°08'W, 378 m, 11.02.1885, id. M.J. RATHBUN as *P. agassizii*: 1 ♂ 33.7 mm; 2 ♀ 44.3, 47.6 mm (USNM 9654). — Stn 2398, 28°45'N, 86°26'W, 409 m, 14.03.1885, id. M.J. RATHBUN as *P. agassizii*: 1 ♀ 60.1 mm (USNM 9743).

"Oregon": stn 126, 29°02'N, 88°34.5'W, 351 m, 23.09.1950: 3 ♂ 33.2-41.2 mm; 2 ♀ 32.6, 41.4 mm (USNM 91443). — Stn 542, 27°41'N, 94°59'W, 450-540 m, 16.04.1952, id. F.A. CHACE as *P. typhlops*: 1 ♀ 38.5 mm (USNM 93661). — Stn 1407, 28°07'N, 89°59'W, 464 m, 20.09.1955, id. F.A. CHACE as *P. typhlops*: 1 ♂ 35.2 mm; 1 ov. ♀ 40.8 mm (USNM 99454). — Stn 3076, 28°30'N, 89°23'W, 41 m, 25.10.1960: 2 ♂ 34.7, 41.3 mm; 5 ♀ 37.7-54.4 mm; 1 ov. ♀ 45.6 mm (USNM 273140). — Stn 3651, 29°12'N, 88°03'W, 450-540 m, 25.07.1962: 2 ♀ 45.6, 56.6 mm (USNM 244083). — Stn 4005, 29°07.5'N, 88°09'W, 540 m, 23.10.1962: 1 ♂ 34.8 mm (USNM 273140). — Stn 4703, 27°55'N, 90°28'W, 540 m, 22.02.1964: 1 ♂ 28.3 mm; 5 ♀ 22.0-33.7 mm (USNM 273140). — Stn 4729, 27°46'N, 92°13'W, 540 m, 26.02.1964: 1 ♂ 20.9 mm; 1 ♀ 30.6 mm (USNM 260368). — Stn 5107, 29°15'N, 80°05'W, 378 m, 16.11.1964: 2 ♂ 40.0, 42.3 mm (USNM 273140). — Stn 5240, 29°39'N, 80°11.5'W, 342 m, 10.02.1965: 1 ♂ 40.3 mm; 2 ♀ 53.9, 54.3 mm (USNM 273140).

"Silver Bay": stn 2070, 29°13'N, 79°59'W, 369 m, 2.05.1960: 1 ♀ 52.5 mm; 1 ov. ♀ 43.1 mm (USNM 232276). — Stn 5464, 29°25'N, 80°07'W, 310 m, 11.02.1964: 4 ♂ 38.8-42.2 mm; 6 ♀ 40.1-45.6 mm (USNM 260368).

"Success": stn 1, 29°21.30'N, 88°21.48'W, 379-430 m, 24.02.1989, id. as *Stereomastis nana* by M.K. WICKSTEN: 1 ♂ 40.0 mm (LACM). — Stn 58, 29°04.03'N, 88°25.12'W, 411-418 m, 26.10.1989, id. as *Stereomastis nana* by M.K. WICKSTEN: 1 ♂ 42.2 mm (LACM).

Panama. *Golfo de Escudo de Veraguas*. *"Oregon"*: stn 3583, 9°16'N, 81°37'W, 512 m, 25.05.1962: 3 ♂ 38.6-43.7 mm (RMNH). — Stn 3598, 9°03'N, 81°22'W, 360-396 m, 31.05.1962, id. F.M. BAYER as *P. agassizii*: 1 ♂ 41.0 mm (USNM 154396).

Caribbean Sea. *"Oregon"*: stn 2774, 11°32'N, 62°40'W, 351-382 m, 19.04.1960, 1 ♂ 41.4 mm; 1 ov. ♀ 48.2 mm (USNM 232276). — Stn 2779, 11°35'N, 62°59'W, 468-432 m, 20.04.1960: 1 ♂ 45.4 mm; 1 ♀ 40.1 mm (USNM 232276).

"Pillsbury": stn 776, 12°13.3'N, 72°50'W, 408-576 m, 29.07.1968: 1 ♂ 35.5 mm; 1 ♀ 35.4 mm (RMNH).

Surinam. *"Snellius"*: stn B22, 7°21.6'N, 55°22.2'W, 400-420 m, 27.04.1966: 2 juvs. (RMNH). — Stn F36, 7°26'N, 56°21.8'W, 365-410 m, 5.05.1966: 2 juvs. (RMNH).

TYPES. — The male (131 mm total length) (IRScNB 16808) collected by the *"Mbizi"* stn AS 35, off West Africa (7°16'S 12°01'E, 440 m) is the holotype. The females (50.7, 45.8 mm cl) (RMNH 8622) collected at stn AS154 (0°15'S, 8°47'E, 239 m) are paratypes.

DESCRIPTION. — Dorsal surface of carapace setose, prominently spinulate. Frontal margin concave. Median submarginal tooth prominent. Single rostral spine antrorse. Internal angle of orbital sinus triangular, spinose; external margin pectinate. Internal margin of orbit mesially pectinate, dividing orbit into two. Eyestalk bearing upcurved spine. Basal antennular segment produced anteriorly to a sharp point, mesial margin spinose, anterolateral margin rounded, bispinose. Spines on lateral margins of carapace upcurved. Spine formula of lateral margin of carapace 7-9:4-5:17-20; spines successively decrease in size posteriorly. Median postrostral carina granulate, irregularly spinulate, postcervical carina with paired spinules. Postorbital carina obsolescent, comprising five antrorse spines, anteriormost largest. Posterior margin of cervical groove spinose between branchial carinae. Branchial carina prominent, parallel with lateral margin, bearing 12-15 spines; region between branchial and median postcervical carinae prominently spinulose. Posterior margin of carapace bearing seven or more pairs of antrorse spines, submedian spines largest.

Abdominal tergites densely granulate, medially carinate. Carinae on tergites 2-5 bearing antrorse spines, fourth and fifth more prominent, salient. Sixth tergite prominently granulate, bearing mesially twin parallel rows of granules, confluent posteriorly. Anterior margin of first tergite bearing nearly 30 denticles. Anterior and posterior margins of tergites 2-5 prominently denticulate. Pleura prominently granulate, margins denticulate. Second pleuron rounded; pleura 3-5 with curved, granulate rib mesially. Telson with granulate median crest anteriorly, two minutely serrulate, convergent carinae posteriorly. Inferior surface of uropodal expopod tricarinate.

Upper margin of merus of P1 spinulate with subterminal claw-like spine, lower margin finely granulose; carpus half as long as merus, two serrulate rows distally on upper margin, subterminal spines on upper and lower margins; upper margin of propodus with several rows of antrorse spinules, lower margin with two minutely spinulate rows. P5 simple in male, chelate in female.

Source : MNHN, Paris

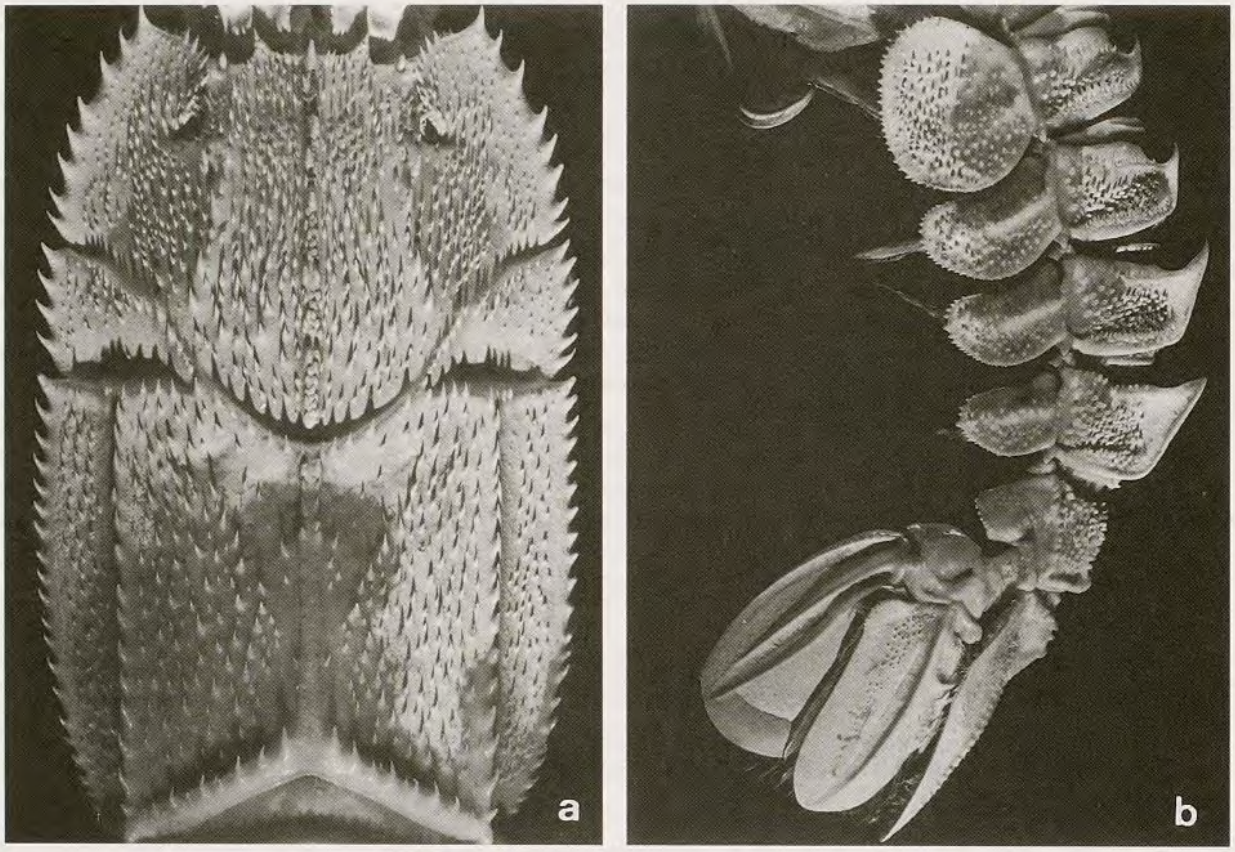

FIG. 21. — *Polycheles perarmatus* Holthuis, 1952, ♂ 50.8 mm, Congo, 4°49'S, 11°17'W, 300-600 m (MNHN-Pa 1575): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

REMARKS. — *P. perarmatus* is distinguished from *P. typhlops* by the rounded second pleuron, the three carinae ventrally on the uropodal expopod, the prominently granulate sixth tergite, the seven pairs of spines on the posterior margin of the carapace and the evenly denticulate anterior margin of the first abdominal tergite.

DISTRIBUTION. — Eastern Atlantic: Gulf of Guinea to Angola, Azores; Western Atlantic: Gulf of Mexico, Caribbean, Panama; 41-650 m.

Polycheles phosphorus (Alcock, 1894)

Fig. 22

Pentacheles phosphorus Alcock, 1894: 240. — WOOD-MASON & ALCOCK, 1894, pl. 8 fig. 2. — ALCOCK & ANDERSON, 1894: 165. — ANDERSON, 1896: 98. — THOMSON, 1901: 18. — ALCOCK, 1901a: 74; 1902: 134. — LLOYD, 1907: 6. — HANSEN, 1925: 142. — BOAS, 1939, fig. 1.

Polycheles phosphorus - ALCOCK, 1899: 33; 1901b: 168. — CALMAN, 1910: 59, fig. 38; 1911, fig. 46. — KEMP & SEWELL, 1912: 24. — BALSS, 1924: 177, fig. 2. — DUNCAN, 1948: 69.

Stereomastis andamanensis - DE MAN, 1916: 16, pl. 1 figs 2-2b (p.p.). — TAKEDA & HANAMURA, 1994: 31. — GRIFFIN & STODDART, 1995: 244 (p.p.) [non Alcock, 1894].

Stereomastis phosphorus - CALMAN, 1927: 55, fig. 37. — DAHL, 1953: 46. — FIRTH & PEQUEGNAT, 1971: 68. — MONOD, 1973: 126, figs 40-44 (p.p.). — HOLTHUIS, 1984: 4.

not *Polycheles phosphorus* - RATHBUN, 1906: 898 [= *P. surdus* sp. nov.].

not *Stereomastis phosphorus* - DE MAN, 1916: 15 [= *P. aculeatus* sp. nov.].

not *Stereomastis phosphorus* - GRIFFIN & STODDART, 1995: 246 [= *P. aculeatus* sp. nov., *P. auriculatus* Bate, 1878, *P. surdus* sp. nov.].

Source : MNHN, Paris

MATERIAL EXAMINED. — **Central Eastern Pacific.** *"Te Vega"*: stn 58, 1°31'N, 128°13'W, 525-570 m, 27.09.1963: 1 ♀ 47.0 mm (USNM).

Vanuatu. MUSORSTOM 8: stn CP 1074, 15°48.42'S, 167°24.27'E, 775-798 m, 4.10.1994: 1 juv. (MNHN-Pa 1738). — Stn CP 1076, 15°53'S, 167°30'E, 1100-1191 m, 4.10.1994: 1 juv. (MNHN-Pa 1739). — Stn CP 1089, 15°57.30'S, 167°27.73'E, 799-850 m, 5.10.1994: 2 juvs (MNHN-Pa 1740).

New Caledonia. 22°02'S, 165°57'E, 800 m, 1971, det. Th. MONOD *Stereomastis phosphorus*: 1 ♂ 27.3 mm (MNHN-Pa 1576).

BATHUS 2: stn CP 743, 22°35.6'S, 166°26.2'E, 713-950 m, 14.05.1993: 2 ♂ 32.4, 37.1 mm (MNHN-Pa 1578). — Stn CP 751, 22°24.35'S, 166°12.83'E, 1300-1500 m, 15.05.1993: 1 ♀ 22.5 mm (MNHN-Pa 1579).

Chesterfield Islands. MUSORSTOM 5: stn 324, 21°15.01'S, 157°51.33'E, 970 m, 14.10.1986: 1 ♀ 20.5 mm (MNHN-Pa 1577).

Australia. *Coral Sea. "Franklin"*: 10°34.28'S, 144°21.99'E, 990-1053 m, 21.08.1988, id. H.E. STODDART as *Stereomastis andamanensis*: 1 ♂ 33.3 mm (AM P40367).

N.W. Coast. "Solea" N.W. Port Headland, 18°48'S, 116°21'E, 694-704 m, 5.04.1982: 1 ♂ 44.8 mm (WAM C13436).

Japan. *"Albatross"*: stn 4906, Koshiki Is, 31°39'N, 129°20'E, 664-731 m, 11.08.1906: 2 ♀ 26.3, 44.5 mm (USNM). — Stn 4911, Koshiki Is, 31°38'30"N, 129°19'E, 794 m, 12.08.1906: 1 ♂ 37.9 mm; 1 ♀ 45.3 mm, 2 juvs (USNM). — Stn 4912, Koshiki Is, 31°39'40"N, 129°20'E, 704 m, 12.08.1906: 2 ♂ 32.0, 38.5 mm; 1 ♀ 46.3 mm; 3 juvs (USNM). — Stn 4915, Koshiki Is, 31°31'N, 129°25'30"E, 769 m, 12.08.1906: 2 ♂ 33.6, 41.2 mm (USNM).

Suruga Bay, off Fuji River, 200 m, 9.12.1975: 1 ♂ broken (NFU 530-2-1495). — S.W. Kyushu, 30°32'N, 128°25'E, 700-750 m, 15.06.1978, colls O. TABETA & K. HAYASHI: 3 ♂ 39.9-40.0 mm (NFU 530-2-1490); 1 ♀ 47.8 mm; 2 ov. ♀ 49.7, 51.3 mm (NFU 530-2-1527).

East China Sea. *"Yuryo Maru"*: 29°38.92'N, 127°55.95'E, 750 m, 4.02.1978, det. Y. MIYA as *Stereomastis andamanensis*: 6 ♂ ; 1 ov. ♀ ; 3 ♀ (NUM cr10229). — 29°23.01'N, 127°30.92'E, 650-642 m, 5.02.1978, det. Y. MIYA as *Stereomastis andamanensis*: 1 ♂ 37.8 mm; 1 ♀ 36.8 mm (NUM cr10231).

"Ryoan Maru" (det. Y. MIYA as *Stereomastis andamanensis*): 28°53'N, 127°18'E, 820-830 m, 16.03.1978: 6 ♂ ; 1 ♀ ; 2 ov. ♀ (NUM cr10230). — 28°43'N, 127°14'E, 750-755 m, 11.03.1978: 6 ♂ 31.3-36.5 mm; 3 ov. ♀ 47.6-53.0 mm; 1 ♀ 47.4 mm (NUM cr10232). — 28°44'N, 127°01'E, 610-640 m, 11.03.1978: 1 ♂ 41.6 mm; 3 ov. ♀ 47.4-51.3 mm; 3 ♀ 50.5-51.6 mm (NUM cr10233). — 28°42'N, 127°09'E, 500-535 m, 11.03.1978: 2 ♂ 26.0, 26.5 mm (NUM cr10234). — 28°35'N, 127°10'E, 600 m, 16.03.1978: 3 ♂ ; 2 ov. ♀ ; 4 ♀ (NUM cr10235). — 28°45'N, 127°07'E, 542-530 m, 16.03.1978: 2 ♂ 34.1, 39.5 mm; 3 ov. ♀ 47.1-59.2 mm; 2 ♀ 41.0, 51.0 mm (NUM cr10236). — 28°50'N, 127°14'E, 700-740 m, 16.03.1978: 9 ♂ 26.7-40.1 mm; 3 ov. ♀ 41.4-50.8 mm; 6 ♀ 27.7-58.7 mm (NUM cr10237). — 29°46'N, 127°59'E, 710-713 m, 20.03.1978: 3 ov. ♀ 26.7-54.8 mm (NUM cr10240). — 29°44'N, 128°03'E, 815 m, 20.03.1978: 1 ♀ 35.5 mm (NUM cr10241). — 29°49'N, 128°06'E, 915-932 m, 20.03.1978: 2 ♀ damaged (NUM cr10242).

South China Sea. W. Borneo. 6°05'N, 110°07'E, 6.11.1964, coll. A.J. BRUCE: 1 ♂ 35.8 mm; 1 ♀ 50.9 mm (RMNH 23484).

Indonesia. *"Siboga"*: (det. DE MAN as *Stereomastis andamanensis*): stn 18, 7°28.2'S, 115°24.6'E, 1018 m, 18.03.1899: 1 juv. (ZMA). — Stn 85, 0°36.5'S, 119°29.5'E, 724 m, 17.06.1899: 2 ♂ 43.9, 44.4 mm (ZMA). — Stn 137, 0°23'S, 127°29'E, 472 m, 3.08.1899: 1 ♂ 20.3 mm (ZMA). — Stn 314, 7°36'S, 117°30.8'E, 694 m, 17.02.1900: 1 ♂ 41.6 mm; 1 ♀ 38.3 mm (ZMA).

"Albatross": stn 5613, Sulawesi, Gulf of Tomini, 0°42'S, 121°44'E, 1376 m, 2.11.1909: 1 juv. (USNM). — Stn 5646, 5°31'30"S, 122°22'40"E, 834 m, 16.12.1909: 1 juv. (USNM). — Stn 5658, Gulf of Boni, 3°32'40"S, 120°31'30"E, 918 m, 19.12.1909: 1 ♂ 44.7 mm (USNM).

CORINDON: stn CH 209, 0°07.3'S, 117°53.8'E, 490 m, 31.10.1980: 10 ♂ 20.8-36.2 mm; 10 ♀ 20.1-51.7 mm (MNHN-Pa 1588). — Stn CH 214, 0°31.4'N, 117°50.1'E, 595 m, 1.11.1980: 1 ♂ 42.9 mm (MNHN-Pa 1589). — Stn CH 217, 0°38.2'N, 117°59.6'E, 470-447 m, 1.11.1980: 1 ♂ 39.2 mm; 1 ♀ 19.8 mm (MNHN-Pa 1590). — Stn CH 240, 0°37'N, 119°33'E, 675 m, 5.11.1980: 1 ♂ 43.2 mm; 2 juvs (MNHN-Pa 1591). — Stn CH 276, 1°54.6'S, 119°13.8'E, 456-395 m, 8.11.1980: 1 ♂ 29.7 mm; 3 ♀ 24.7-48.4 mm (MNHN-Pa 1592). — Stn CH 280, 1°59.0'S, 119°09.9'E, 715-800 m, 8.11.1980: 1 juv. (MNHN-Pa 1593). — Stn CH 281, 1°57.5'S, 119°02.0'E, 1120-1150 m, 8.11.1980: 1 juv. (MNHN-Pa 1594).

SNELLIUS 2: stn 4.267, 8°17.6'S, 118°21.3'E, 650 m, 29.10.1984: 4 ♂ 24.7-35.4 mm; 4 ♀ 19.2-37.3 mm (RMNH). — Stn 4.276, 8°12'S, 118°12'E, 750 m, 31.10.1984: 1 ♂ 40.2 mm; 2 ov. ♀ 47.8, 43.3 mm (RMNH).

KARUBAR: *Tanimbar I.*: stn CP 38, 7°40'S, 132°27'E, 620-666 m, 28.10.1991: 2 juvs (MNHN-Pa 1580). — Stn CP 54, 8°21'S, 131°43'E, 836-869 m, 30.10.1991: 2 ♂ 20.3, 34.7 mm; 3 ♀ 21.7-64.5 mm (MNHN-Pa 1582). — Stn CP 73, 8°29'S, 131°33'E, 855-840 m, 2.11.1991: 1 ♂ 33.0 mm; 1 ♀ 49.2 mm (MNHN-Pa 1583). — Stn CP 81, 9°35'S, 131°02'E, 200-207 m, 4.11.1991: 2 ♂ 31.2, 50.7 mm; 2 juvs (MNHN-Pa 1584).

Philippines. *"Albatross"*: stn 5114, Balayan Bay, 13°36'11"N, 120°45'26"E, 622 m, 20.01.1908: 2 ♀ 27.1, 32.7 mm (USNM). — Stn 5286, Luzon, 13°38'15"N, 120°34'20"E, 823 m, 20.07.1908: 1 ♂ 44.8 mm (USNM). — Stn 5349, Palawan Passage, 10°54'N, 118°26'20"E, 1335 m, 27.12.1908: 2 ♂ 28.8, 42.8 mm; 2 juvs (USNM).

Source : MNHN, Paris

MUSORSTOM 1: stn 47, 13°40.7'N, 120°30'E, 757-685 m, 25.03.1976: 1 ♂ 44.2 mm; 3 ♀ 34.9-44.8 mm (MNHN-Pa 1587).

MUSORSTOM 2: stn CP 50, 13°37'N, 120°33'E, 810-820 m, 27.11.1980: 1 ♂ 28.9 mm (MNHN-Pa 1585). — Stn CP 55, 13°54'N, 119°58'E, 865 m, 27.11.1980: 1 ♂ 22.8 mm (MNHN-Pa 1586).

Bay of Bengal. *"Investigator"*: stn 112, 13°47'30"N, 92°36'E, 1026 m, 7.11.1890: 1 ♀ 54.0 mm (IM 6873/9).

Ceylon. *"Investigator"*: stn 377, 5°51'N, 80°26'E, 1107 m, 25.04.1907: 2 ♀ 26.0, 28.0 mm (IM 5814/10).

Laccadive Sea. *"Investigator"*: stn 177, 13°47'49"N, 73°07'E, 1166 m, 5.05.1894: 1 ♀ 38.7 mm (USNM 19012; ex. IM).

TYPE. — The female (54.0 mm cl) (IM 6873/9) collected by the "*Investigator*" at stn 112, Bay of Bengal (13°47'30"N, 92°36'E, 1026 m), is the holotype of *Pentacheles phosphorus* (Alcock, 1894).

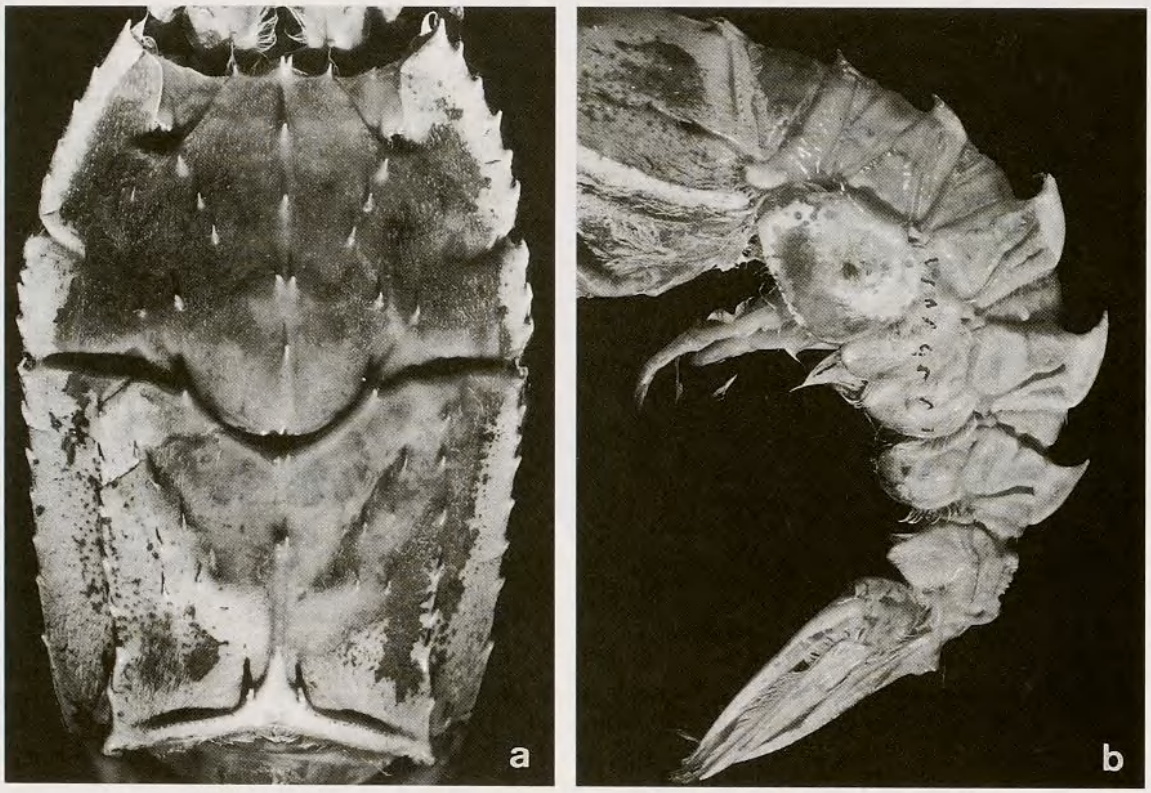

FIG. 22. — *Polycheles phosphorus* (Alcock, 1894), ♀ 43.6 mm, East China Sea, *"Ryoan Maru"*, 28°50'N, 127°14'E, 700-740 m (NUM 10237): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

DESCRIPTION. — Lateral margins of carapace anteriorly convergent. Dorsal surface of carapace setose. Rostrum bifid. Small spine on internal angle of orbital sinus, external angle unarmed. Eye stalk bearing mammilate tubercle, curved distad. Basal antennular segment produced anteriorly to a sharp point, mesial margin smooth, anterolateral margin unispinose. Spines on lateral margins of carapace upcurved. Spine formula of lateral margin of carapace 6:3:6-7, posteriormost spine further apart. Spine formula of median postcervical carina (excluding rostral spines) 1:1:2:1; median postcervical carina bearing two pairs of spines. Gastro-orbital region with five prominent antrorse spines in arcuate row. Posterior margin of cervical groove with antrorse spine midway between median postcervical and lateral carinae. Branchial carina prominent, bearing 6 or 7 spines. Anteriorly between branchial and median carinae shallow diagonal groove, 5 or 6 spines posterior to groove. Posterior margin of carapace bearing antrorse submedian spines.

Abdominal tergites medially carinate. Carinae on tergites 1-5 bearing antrorse spines, 3 and 4 largest. Sixth tergite boldly sculptured, raised lateral margins, mesially bearing prominently denticulate double carinae, confluent at posterior margin. Anterior margin of first tergite with two pairs of lateral spines. Tergites 2-5 bearing deep,

Source : MNHN, Paris

transversely oblique, submedian grooves with raised margins. Pleura 2-5 with curved rib mesially, bolder posteriorly, margins minutely denticulate. Second pleuron ovate. Telson with short crest anteriorly, two minutely serrulate, confluent carinae posteriorly.

Merus of P1 proximally bispinose, claw-like spine subterminally on upper margin, finely granulose on lower margin; carpus 2/3 as long as merus, subterminal spines on upper, lower margins; upper margin of propodus with subterminal spine, lower margin with two mintely spinulate rows. P5 subchelate in male, chelate in female.

Color. — "bright pink" (ALCOCK, 1894: 241).

REMARKS. — ALCOCK (1894: 240) clearly distinguished *phosphorus* as having on its "basal joint of the antennules..... a single spine at the antero-external angle", and further (1901b): "some spines flanking the cardio-branchial grooves". Misunderstanding the significance of these characters, authors mistook various polychelid species for *phosphorus*. DE MAN (1916) and GRIFFIN & STODDART (1995) mingled both *nanus* and *phosphorus* and misidentified them as *andamanensis*, whereas their *phosphorus* are different species - in fact, GRIFFIN & STODDART (1995: 246) had three different species identified as *Stereomastis phosphorus*.

DISTRIBUTION. — Vanuatu, New Caledonia, Australia, Japan, China Sea, Indonesia, Philippines, Bay of Bengal, Ceylon, Laccadive Sea; 200 m (present work) - 1354 m (TAKEDA & HANAMURA, 1994).

Polycheles politus sp. nov.

Fig. 23

MATERIAL EXAMINED. — **Philippines**. *"Albatross"*: stn 5219, btw Marinduque & Luzon, 13°21'N, 122°18'45"E, 969 m, 23.04.1908: 7 ♀ 25.6-49.6 mm (USNM). — Stn 5423, Cagayan Is, 9°38'30"N, 121°11'E, 914 m, 31.03.1909: 1 ♂ 19.1 mm; 2 juvs (USNM). — Stn 5424, Cagayan Is, 9°37'05"N, 121°12'37"E, 622 m, 31.03.1909: 1 ♂ 19.1 mm; 1 ♀ 24.9 mm (USNM). — Stn 5488, Panaon I., Leyte, 10°00'N, 125°06'45"E, 1412 m, 31.07.1909: 1 ♂ 18.4 mm; 3 juvs (USNM). — Stn 5492, Mindanao, 9°12'45"N, 125°20'E, 1344 m, 1.08.1909: 1 ♀ 34.3 mm (USNM). — Stn 5494, Mindanao, 9°06'30"N, 125°18'40"E, 1220 m, 2.08.1909: 2 ♂ 17.9, 22.4 mm (USNM). — Stn 5495, Mindanao, 9°06'30"N, 125°00'20"E, 1785 m, 2.08.1909: 1 ♀ 23.1 mm (USNM). — Stn 5511, Mindanao, 8°15'20"N, 123°57'E, 750 m, 7.08.1909: 1 ♀ 23.1 mm (USNM). — Stn 5514, Mindanao, 8°32'42"N, 123°58'36"E, 1275 m, 8.08.1909: 1 ♀ damaged (USNM).

MUSORSTOM 2: stn CP 38, 12°53.5'N, 122°26.6'E, 1650-1660 m, 25.11.1980: 2 ♂ 21.5, 25.1 mm; 5 ♀ 20.7-37.0 mm (MNHN-Pa 1595). — Stn CP 39, 10°02.8'N, 122°37.1'E, 930-1190 m, 25.11.1980: 19 juvs (MNHN-Pa 1596). — Stn CP 40, 13°07.7'N, 122°39.1'E, 280-440 m, 25.11.1980: 1 ♀ 21.8 mm (MNHN-Pa 1597). — Stn CP 42, 13°04.2'N, 122°25.0'E, 1580-1610 m, 25.11.1980: 1 ♂ 21.7 mm; 2 ♀ 22.3, 31.7 mm (MNHN-Pa 1598). — Stn CP 44, 13°23.2'N, 122°20.7'E, 760-820 m, 26.11.1980: 1 ♂ 27.5 mm; 5 juvs (MNHN-Pa 1599).

Gulf of Thailand. *"Galathea"*: stn 324, Str. of Malacca, 6°06'N, 96°00'E, 1130 m, 9.05.1951: 1 ♀ 25.3 mm (ZMC). — Stn 443, Mindanao Sea, 8°48'N, 124°09'E, 1570 m, 16.08.1951: 1 ♂ 22.6 mm; 3 ♀ 26.4-28.3 mm; 3 juvs (ZMC).

Indonesia. *"Albatross"*: stn 5629, Moluccas, S. Doworra I., 0°50'S, 128°12'E, 375 m, 2.12.1909: 1 ♂ 17.3 mm (USNM).

TYPES. — The male (25.1 mm cl) (MNHN) collected by MUSORSTOM 2, stn CP 38 (12°53.5'N, 122°26.6'E, 1650-1660 m) off the Philippines, is the holotype. The other specimens in the sample are paratypes.

DESCRIPTION. — Margins of carapace anteriorly convergent. Dorsal surface of carapace setose. Rostrum bifid. Internal angle of orbital sinus with minute spine, external angle unarmed. Eyestalk bearing minute mammilate tubercle, curved distad. Basal antennular segment elongate, produced anteriorly to a sharp point, mesial margin smooth, anterolateral margin unispinose. Spines on lateral margins of carapace upcurved, anteriormost largest. Spine formula of lateral margin of carapace 6:3:6-7, posteriormost spine further apart. Spine formula of median postrostral carina (excluding rostral spines) 1:1:2:1, median postcervical carina bearing two pairs of spines. Gastro-orbital region quadrispinose, anterior spine larger by far. Posterior margin of cervical groove with antrorse spine between median postcervical carina and lateral margin of carapace. Branchial carina obsolescent, prominent spine (sometime preceded by spinules) near posterior margin of carapace. Posterior margin of carapace bearing antrorse submedian spines.

Source : MNHN, Paris

Abdominal tergites medially carinate. Anterior margin of first tergite with two pairs of prominent lateral spines. Carinae on tergites 1-4 bearing antrorse spine, spine of third tergite longest; carina of fifth tergite unarmed. Sixth tergite smooth, mesially bearing lyre-shaped denticulate carina. Tergites 2-5 bearing shallow, transversely oblique, submedian grooves. Pleura 2-5 with obsolescent curved rib mesially, margins minutely denticulate. Second pleuron ovate, bearing spine on anterior margin. Telson with short crest anteriorly, two minutely serrulate, confluent carinae posteriorly.

Merus of P1 proximally bispinose with subterminal claw-like spine on upper margin, finely granulose on lower margin; carpus 2/3 as long as merus, subterminal spines on upper and lower margins; upper margin of propodus with subterminal spine, lower margin granulate. P5 subchelate in male, chelate in female.

ETYMOLOGY. — The Latin *politus* (= polished) refers to the smooth, unarmed carapace of the species.

REMARKS. — Both *P. phosphorus* and *politus* have but a single spine on the anterolateral margin of the basal antennular segment, however, *politus* is clearly distinguished from *phosphorus* by its unarmed fifth abdominal carina, the obsolescent branchial carinae, and the postcervical part of the carapace, between the branchial and median carinae, lacking spines.

DISTRIBUTION. — Philippines, Gulf of Thailand, Indonesia; 280-1785 m.

Polycheles sculptus Smith, 1880

Fig.24

Polycheles typhlops - NORMAN, 1878: 382 (p.p.); 1879: 175 (p.p.).

Polycheles sculptus Smith, 1880a: 346, pl. 7 figs 1-6; 1880b: 269. — FAXON, 1893: 196; 1895: 121, pl. C fig. 2; 1896: 155. — CAULLERY, 1896: 385. — KOEHLER, 1896: 721 (list). — ALCOCK, 1901b: 170. — STEBBING, 1902: 36. — SENNA, 1902: 338. — JOUBIN, 1905: 75, fig. 58. — BOUVIER, 1905a: 480; 1905c: 3; 1905d: 4; 1915: 2; 1917: 51, pl. 3, fig.1; 1925: 438, fig 11, pl. 7 fig. 1. — HANSEN, 1908: 41. — STEBBING, 1910: 377. — ANDREWS, 1911: 428, figs 11-15. — MURRAY & HJORT, 1912: 538. — SELBIE, 1914: 18, pl. 2, figs 1-9. — SUND, 1915: 372. — WILLIAMSON, 1915: 457. — BALSS, 1925: 201. — BOONE, 1930: 86, pl. 23 fig. b. — MIRANDA & RIVERA, 1933: 17. — DELPHY & MAGNE, 1938: 83 (list). — BOAS, 1939: 4, figs 3, 7-8. — ZARIQUIEY, 1946: 99. — LE DANOIS, 1948: 150 (list). — SPRINGER & BULLIS, 1956: 14. — HOLTHUIS, 1962: 183. — CHINA, 1964: 111. — BARNARD, 1964: 12 (list). — PÉRÈS & PICARD, 1964: 105. — ALLEN, 1967: 56. — PÉRÈS, 1967: 519. — RODRIGUEZ, 1980: 194.

Pentacheles spinosus A. Milne Edwards, 1880: 66. — FILHOL, 1885: 139, fig. 44. — W. MARSHALL, 1888: 267, fig. 88. — YOUNG, 1900: 442. — SEELIGER, 1901: 43. — BOUVIER, 1925: 438, figs 11-12, pl. 7 fig.1.

Willemoesia leptodactyla - GIGLIOLI, 1881: 358; 1882: 5; 1912: 186 [non Willemoes-Suhm, 1875].

Pentacheles sculptus - SMITH, 1882: 23, pls 3-4; 1884: 358 (list); 1886a: 188; 1886b: 607 (list). — VERRILL, 1882: 364; 1884: 653; 1885: 554; pl. 34 fig. 152. — AGASSIZ, 1888: 42, fig. 239. — ALCOCK & ANDERSON, 1899: 289.

Stereomastis sculpta - DE MAN, 1916: 8. — STEPHENSEN, 1923: 66. — CALMAN, 1925: 18; 1927: 55. — BOONE, 1927: 90. — BARNARD, 1950: 572, fig. 105d. — HOLTHUIS, 1952b: 11, fig. 3; 1962: 182; 1984: 4; 1987: 297, fig. 2; 1991, fig. 169. — BERNARD, 1953: 87. — SIVERSTEN & HOLTHUIS, 1956: 41. — DOLLFUS, 1956: 135 (list). — SQUIRES, 1965: 88, figs 37-38; 1966: 2. — KENSLEY, 1968: 29; 1981a: 60 (list); 1981b: 29 (list). — ZARIQUIEY, 1968: 210. — CARPINE, 1970a: 11 (list); 1970b: 135 (list). — FIRTH & PEQUEGNAT, 1971: 69. — RELINI-ORSI & RELINI, 1972: 59, fig. 5. — RELINI-ORSI, 1973: 29. — LAGARDÈRE, 1973: 93; 1977a: 399. — THIRIOT, 1974: 344 (list). — WILLIAMS & WIGLEY, 1977: 8. — BAEZ & ANDRADE, 1979: 225, pl. 1 fig. 6. — PEQUEGNAT & JEFFREY, 1979: 72. — WENNER, 1979: 441. — BEAUBRUN, 1979: 40, fig. 21. — ANDRADE & BAEZ, 1980: 262 (list). — BURUKOVSKY *et al.*, 1982: 523. — BURUKOVSKY, 1983: 134, fig. 179. — TAKEDA & OKUTANI, 1983: 75. — POHLE, 1985: 21. — ANDRADE, 1986: 45. — DURIS, 1987: 9. — MACPHERSON, 1988: 58, fig. 5b. — ABELLO & VALLADARES, 1988: 98. — PEQUEGNAT *et al.*, 1990: 63. — SQUIRES, 1991: 360, figs 190-191. — ABELLO & CARTES, 1992: 109. — CARTES & ABELLO, 1992: 139. — CARTES & SARDA, 1992: 1315. — FALCIAI & MINERVINI, 1992: 134. — CARTES, 1993: 32 (list). — CARTES *et al.*, 1993: 210. — EMMERSON, 1993: 181. — QUACKENBUSH, 1994: 85. — GONZALEZ, 1995: 126. — GRIFFIN & STODDART, 1995: 248. — TIEFENBACHER, 1995: 8, fig. 3.

Stereomastis sculptus - STEBBING, 1917: 30.

Stereomastis sculpta - FIRTH & PEQUEGNAT, 1971: 69. — WENNER & BOESCH, 1979: 131. — DAWSON, 1997: 21.

Stereomastis andamanensis – TUNG *et al.*, 1988: 45, fig. 45a-f.

not *Polycheles sculptus* - BRUUN, 1950: 24, fig. 16 [= *P. talismani* Bouvier, 1917].

Source : MNHN, Paris

not *Stereomastis sculpta* - HOLTHUIS, 1952b: 11. — LONGHURST, 1958: 32. — FOREST, 1963: 627. — MACPHERSON, 1983: 48. — RUCABADO & BAS, 1984: 19 [= *P. talismani* Bouvier, 1917].
not *Stereomastus sculpta* - GAULD, 1960: 63), [erroneous spelling] [= *P. talismani* Bouvier, 1917].
not *Polycheles sculptus* - DEL SOLAR, 1972: 11 [= *P. pacificus* Faxon, 1893].

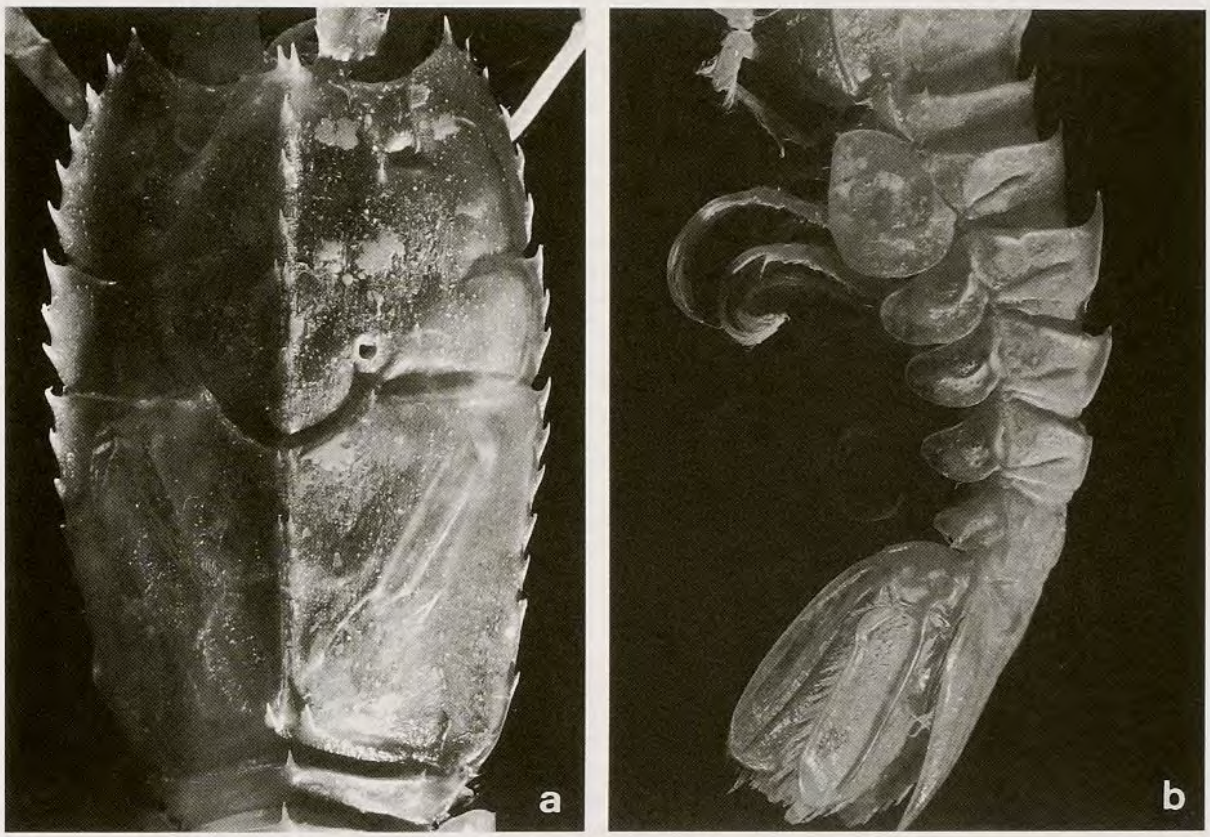

FIG. 23. — *Polycheles politus* sp. nov., ♂ 25.1 mm, holotype, Philippines, MUSORSTOM 2 stn CP 38, 12°53.5'N, 122°26.6'E, 1650-1660 m (MNHN-Pa 1595): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

MATERIAL EXAMINED. — **Mediterranean Sea**. *"Washington"*: 41°15'09"N, 8°10'41"E, 2150 m, 4.08.1881, coll. & id. E.H. GIGLIOLI as *Willemoesia leptodactyla* : 1 juv. damaged (MF). — 41°14'38"N, 8°18'05"E, 2145 m, 8.08.1881, coll. & id. E.H. GIGLIOLI as *W. leptodactyla*: 1 ♂ 21.2 mm (MF). — 41°24'42"N, 7°43'28"E, 2836-2809 m, 9.08.1881, coll. & id. E.H. GIGLIOLI as *W. leptodactyla*: 1 ♀ 25.1 mm (MF).

Ibero-Moroccan Gulf. BALGIM: stn CP 69, 35°11'N, 7°50'W, 1978-2077 m, 5.06.1984: 2 juvs (MNHN-Pa 1600). — Stn CP 92, 34°24'N, 7°30'W, 1182 m, 8.06.1984: 1 juv. (MNHN-Pa 1601). — Stn CP 98, 34°29'N, 7°42'W, 1721-1773 m, 9.06.1984: 2 juvs (MNHN-Pa 1602). — Stn CP 108, 36°11'N, 8°06'W, 1521-1534 m, 10.06.1984: 1 ♀ 31.6 mm (MNHN-Pa 1603).

"Talisman": Cap Bogador, 11.07.1883, 1400 m: 1 damaged (MNHN).

Canary Is. CANCAP 2: stn 27, 27°56'N, 14°28'W, 1440-1540 m, 25.08.1977: 2 juvs (RMNH).

CANCAP 4: stn 4.056, 28°47'N, 13°22'W, 1306-1345 m, 18.05.1980: 2 ♂ 28.5, 41.5 mm; 3 ♀ 26.2-46.0 mm (RMNH). — Stn 4.057, 28°47'N, 13°24'W, 1300-1335 m, 19.05.1980: 3 ♂ 26.8-35.2 mm; 2 ♀ 22.8, 28.0 mm (RMNH).

Western Sahara. *"Meteor"*: stn M36-98 AT149, 25°31.5'N, 16°02.2'W, 658-888 m, 24.02.1975: 1 juv. (SMF 24645).

Mauritania. TYRO: stn 104, 19°43'N, 17°30'W, 1500 m, 17.06.1988: 1 ♂ 42.9 mm; 1 ♀ 53.2 mm (RMNH).

West Africa. *"Pillsbury"*: stn 4, 5°37'N, 3°19'E, 1876-1263 m, 24.05.1964: 1 ♀ 29.1 mm (RMNH). — Stn 44, 5°05'N, 4°00'W, 586-403 m, 30.05.1964: 1 juv. (RMNH). — Stn 52, 4°54'N, 4°58'W, 952-915 m, 31.05.1964: 1 ♀ 63.1 mm (RMNH). — Stn 53, 4°50'N, 4°55W, 1579-1519 m, 31.05.1964: 1 ♂ 24.8 mm; 1 ♀ 36.1 mm (RMNH). — Stn 233, 5°19'N, 4°14'E, 2013-1464 m, 12.05.1965: 1 ♂ 29.3 mm; 6 ♀ 28.9-33.1 mm (RMNH). — Stn 309, 4°15'N, 4°27'E, 678-720 m, 26.05.1965: 19 ♂ 22.2-54.0 mm; 26 ♀ 22.1-71.4 mm (RMNH).

Source : MNHN, Paris

SE Atlantic. Off Cape province. 34°54.45'S, 18°12.06'E, 1650 m, 14.03.1988: 2 ♂ 33.6, 43.1 mm (USNM 235172).

"Africana": 29°38.8'S, 14°25.4'E, 861 m, 23.01.1990: 5 ♂ 32.7-41.5 mm; 5 ♀ 25.2-50.5 mm (SAM). — 32°26'S, 16°11'E, 1302 m, 27.01.1993: 1 ♀ 30.7 mm (SAM). — 32°22'S, 16°09'E, 1150 m, 14.01.1995: 3 ♂ 31.7-37.6 mm; 5 ♀ 20.1-32.1 mm (SAM).

Labrador Sea. *"Dana"*: stn 16439, off Hudson str., 62°49'N, 60°20'W, 980-1000m, 26.07.1974: 1 ♂ 35.7 mm (ZM CRU3275).

Canada. *Nova Scotia. "Epes Tarr"*: SE Sable I., 43°10'N, 61°20'W, 450 m, coll. Capt. Th. OLSEN: 1 ♂ 38.2 mm (USNM 39957).

United States. *"Albatross"* (id. S.I. SMITH as *Pentacheles sculptus*): stn 1123, off Massachusetts, 1417 m, 26.08.1882: 1 ♂ 31.6 mm (AMNH 15234). — Stn 2115, 35°45'30"N, 74°34'45"W, 1517 m, 11.11.1883: 1 juv. 20.6 mm (AMNH 15535). — Stn 2233, 38°36'30"N, 73°06'00"W, 1134 m, 12.09.1884: 1 ♂ 22.3 mm (AMNH 15745). — Stn 2550, 39°44'30"N, 70°30'45"W, 1811 m, 9.08.1883: 1 ♀ 26.5 mm (AMNH 15445). — Stn 2628, 950 m, 1885: 1 ♀ 35.5 mm (AMNH 5074).

Off Florida, 448-450 m, 3.08.1932, coll. W.L. SCHMITT: 1 ♂ 32.6 mm (USNM 78272).

Gulf of Mexico. *"Albatross"*: stn 2396, 28°34'N, 86°48'W, 603 m, 13.03.1885, id. M.J. RATHBUN: 1 ♂ 29.2 mm, (AMNH 3983).

"Cape Hatteras": 28°23.3'N, 86°43.8'W, 750-818 m, 23.04.1987, coll. H.G. KUCK & J.F. QUINN: 2 ♂ 41.7, 43.1 mm; 1 ♀ 38.0 mm (LACM 87-2691).

"Oregon": stn 2814, 28°53'N, 87°47'W, 1710-1890 m, 13.07.1960: 2 ♀ 38.0, 39.0 mm; 3 juvs (USNM 232276). — Stn 2816, 28°38'N, 88°18'W, 1710 m, 14.07.1960: 3 juvs (USNM 232276). — Stn 2820, 28°23'N, 88°21.5'W, 1800 m, 15.07.1960: 5 ♀ 26.5-39.0 mm (USNM 232276). — Stn 2824, 29°07'N, 88°04'W, 657-711 m, 17.07.1960: 2 ♂ 22.4, 29.2 mm; 2 ♀ 42.1, 43.5 mm (USNM 232276). — Stn 4005, 29°07.5'N, 88°09'W, 540 m, 23.10.1962: 1 ♀ 51.4 mm; 2 ov. ♀ 43.8, 44.2 mm (USNM 273140). — Stn 4147, 24°12'N, 83°32'W, 900 m, 15.12.1962: 1 ♂ 28.5 mm; 3 ♀ 27.1- 56.4 mm; 1 ov. ♀ 53.2 mm, 2 juvs (USNM). — Stn 4531, 24°32'N, 83°36'W, 360 m, 24.11.1963: 2 ♀ 46.9, 51.2 mm; 2 juvs (USNM 279502). — Stn 4561, 24°03'N, 83°15'W, 900 m, 3.12.1963: 4 ♂ 22.0-27.0; 2 ♀ 22.6, 31.9 mm; 1 juv. (USNM 260368). — Stn 4570, 23°11'N, 86°28'W, 900 m, 7.12.1963: 2 ♀ 34.8, 41.3 mm; 1 ov. ♀ 62.5 mm; 1 juv. (USNM 260368). — Stn 5790, 24°22'N, 83°34'W, 648 m, 26.11.1965: 3 ♂ 31.5-44.0 mm (USNM 273140).

Caribbean Sea. *"Oregon"*: stn 1907, 12°25'N, 82°23'W, 720-765 m, 11.09.1957: 2 ♀ 33.7, 44.2 mm (USNM 251942). — Stn 2777, 11°36'N, 62°46'W, 522 m, 19.04.1960: 1 ♀ 47.9 mm (USNM 232276). — Stn 3561, 16°35'N, 80°04'W, 720 m, 18.05.1962: 1 ♀ 44.0 mm (USNM 244083). — Stn 3601, 9°07'N, 81°00'W, 720 m, 31.05.1962: 4 ♀ 32.7-56.5 mm (USNM 244083). — Stn 4293, 7°14'N, 52°55'W, 720 m, 21.03.1963: 1 ♂ 43.0 mm; 3 ♀ 49.2-60.8 mm; 1 ov. ♀ 48.5 mm (USNM 273140). — Stn 4300, 7°44'N, 54°19'W, 540 m, 23.03.1963: 1 ♀ 53.9 mm; 2 ov. ♀ 53.0, 55.6 mm (USNM 273140). — Stn 4412, 11°49'N, 69°24'W, 540 m, 3.10.1963: 11 ♂ 30.0- 39.6 mm; 12 ♀ 28.7-44.5 mm (USNM 273140). — Stn 4413, 11°53'N, 69°25'W, 630 m, 3.10.1963: 2 ♂ 28.0-32.1 mm; 2 ♀ 48.7, 62.8 mm; 2 juvs (USNM 260368); 4 ♂ 28.7-37.8 mm; 2 ♀ 43.5 mm, damaged; 3 ov. ♀ 43.4-50.1 mm; 4 juvs (USNM 273140). — Stn 4414, 11°54'N, 69°23'W, 720 m, 3.10.1963: 2 ♂ 30.0 34.6 mm; 1 ♀ damaged (USNM 260368). — Stn 4428, 11°41'N, 68°57'W, 720 m, 6.10.1963: 3 ♂ 22.1-30.4 mm; 3 ♀ 27.7-50.5 mm (USNM 260368). — Stn 4441, 11°03'N, 67°53'W, 900 m, 9.10.1963: 1 ♀ 70.3 mm; 1 ov. ♀ 65.6 mm (USNM 273140).

"Pillsbury": stn 455, off Guajira, Colombia, 13°01'N, 71°55'N, 27.07.1966: 1 ♂ 42.0 mm; 1 ♀ 42.4 mm; 1 juv. (RMNH). — Stn 478, W. Grenadine Is, 11°34.4'N, 62°10.7'W, 598-597 m, 2.08.1966: 6 ♂ 23.5-46.1 mm; 5 ♀ 23.3-47.4 mm; 1 juv. (RMNH). — Stn 846, 11°37.48'N, 60°37.24'W, Tobago I., 659-1126 m, 2.07.1969: 2 ♂ 25.4, 27.6 mm; 4 ♀ 29.2-50.5 mm; 2 juvs (LACM ex AHF 1969-31). — Stn 850, 11°45.30'N, 61°29.30'W, Tobago I., 896-923 m, 3.07.1969: 2 ♂ 24.4, 29.1 mm; 3 ♀ 30.7-40.5 mm (LACM ex AHF 1969-31).

Guyana. *"Luymes"*: stn 48, 7°45'N, 57°01'W, 500 m, 30.08.1970: 1 ♀ 41.6 mm (RMNH).

Chile. *"Anton Bruun"*: stn 687, 34°07'S, 72°19'W, 750-730 m, 5.08.1966: 3 ♂ 25.4-30.9 mm; 1 ♀ 26.2 mm; 3 juvs (USNM). — Stn 703, 32°09'S, 71°43'W, 960 m, 12.08.1966: 3 ♂ 25.4-26.4 mm; 4 ♀ 31.7-32.4 mm (USNM). — Stn 714, 25°00'S, 70°40'W, 950 m, 16.08.1966: 1 ♂ 26.1 mm; 1 damaged (USNM). — Off Valparaiso, 400 m, 12.02.1966: 1 ♀ 31.2 mm (USNM 266221).

New Zealand. NZOI: stn X 518, 42°52.06'S, 175°39.21'W, 979-922 m, 11.07.1994: 1 ov. ♀ 55.8 mm (NIWA). — Stn K 521, 42°58.16'S, 175°27.91'W, 862-865 m, 11.07.1994: 1 ♀ 22.2 mm (NIWA). — Stn U 197, 34°09.8'S, 163°36.7'E, 1186 m, 25.09.1982: 1 ♂ 26.2 mm (NIWA).

Tasman Sea. *"Kamenskoe"*: 40°32'S, 167°23.5'E, 1140 m, 9.11.1977: 1 ♂ 30.3 mm; 1 juv. (ZMMU).

Vanuatu. MUSORSTOM 8: stn 1075, 15°53.26'S, 167°27.21'E, 956-944 m, 4.10.1994: 4 ♀ 23.3-36.5 mm (MNHN-Pa 1605). — Stn 1076, 15°53.81'S, 167°30.42'E, 1100-1191 m, 4.10.1991: 7 juvs (MNHN-Pa 1714).

Australia. New South Wales. *"Kapala"*: stn K77-23-13, 33°27'S, 152°09'E, 882-914 m, 8.12.1977, id. D. BROWN as *Stereomastis sculpta*: 1 ♀ 48.8 mm; 2 juvs. (AM P40365). — Stn K88-08-04, 32°06'S, 153°08'E, 1025-1080 m, 4.05.1988, id. H.E. STODDART as *Stereomastis sculpta*: 1 ♀ 41.9 mm (AM 40363).

Japan. *"Albatross"*: stn 3696, off Honshu I., 902-1346 m, 5.05.1900: 1 ♀ 35.2 mm (USNM).

Source : MNHN, Paris

East China Sea. *"Yuryo Maru"*: 29°38.92'N, 127°55.95'E, 750 m, 4.02.1978: 2 ov. ♀ 51.6, 56.0 mm (NUM cr10229).

Philippines.*"Albatross"*: stn 5468, Lagonoy Gulf, 13°35'39"N, 123°40'28"E, 1040 m, 18.06.1909: 1 ♀ 66.8 mm (USNM). — Stn 5470, Lagonoy Gulf, 13°37'30"N, 123°41'09"E, 1024 m, 18.06.1909: 1 ♀ 51.3 mm (USNM).

Indonesia.*"Albatross"*: stn 5607, Sulawesi, 00°04'S, 121°36'00"E, 1392 m, 18.11.1909: 1 juv. (USNM). — Stn 5619, Molucca Passage, 00°35'00"N, 127°14'40"E, 795 m, 27.11.1909: 2 juvs (USNM). — Stn 5638, Moluccas, 3°47'15"S, 126°23'40"E, 946 m, 10.12.1909: 1 ♀ 24.3 mm (USNM). — Stn 5648, Buton str., 5°35'00"S, 122°20'00"E, 1022 m, 16.12.1909: 1 juv. (USNM). — Stn 5654, Gulf of Boni, 3°42'00"S, 120°45'50"E, 1472 m, 18.12.1909: 1 juv. (USNM). — Stn 5657, Gulf of Boni, 3°19'40"S, 120°36'30"E, 898 m, 19.12.1909: 1 juv. (USNM). — Stn 5658, Gulf of Boni, 3°32'40"S, 120°31'30"E, 933 m, 19.12.1909: 1 ov. ♀ 56.3 mm (USNM).

"Siboga": stn 18, 7°28'02"S, 115°24'06"E, 1018 m, 18.03.1899: 1 ♂ 40.6 mm (ZMA). — Stn 211, 5°40'07"S, 120°45'05"E, 1158 m, 25.09.1899: 1 juv. (ZMA).

KARUBAR: *Tanimbar Is*: stn CP 52, 8°03'S, 131°48'E, 1244-1266 m, 30.10.1991: 2 juvs (MNHN-Pa 1715). — Stn CP 54, 8°21'S, 131°43'E, 836-869 m, 30.10.1991: 1 ♂ 37.4 mm (MNHN-Pa 1716). — Stn CP 73, 8°29'S, 131°33'E, 855-840 m, 2.11.1991: 1 ♂ 32.8 mm (MNHN-Pa 1606). — Stn CP 81, 9°35'S, 131°02'E, 200-207 m, 4.11.1991: 1 ♂ 40.4 mm (MNHN-Pa 1607).

Bali Sea. *"Galathea"*: stn 489, 7°38'S, 116°08'E, 1195-1165 m, 13.09.1951: 1 ♂ 40.2 mm (ZMC).

Ceylon. *"Investigator"*: stn 321, 5°04'08"N, 80°22'E, 1208 m, 15.11.1903: 1 ov. ♀ 59.5 mm (IM 4003/10).

Gulf of Aden. *"Meteor 5"*: stn Me5-268, 13°11.2'N, 47°10.9'E, 1654-1686 m, 13.03.1987: 1 ♂ 27.2 mm; 1 ♀ 42.2 mm; 1 juv. (SMF 24651). — Stn Me5-277, 12°37.5'N, 46°09.4'E, 1552-1554 m, 14.03.1987: 1 ♂ 32.9 mm; 1 ♀ 46.7 mm; 2 juvs (SMF 24650).

Comoro Is. BENTHEDI: stn CA 31, 12°37.4'S, 45°25.2'E, 1800 m, 25.03.1977: 2 ♂ 20.4, 24.4 mm (MNHN-Pa 1709).

Madagascar. *"Vauban"* (A. CROSNIER coll.): stn CH 126, 17°50'S, 43°07'E, 1475-1530 m, 16.1.1975: 1 ♂ 29.1 mm; 1 ♀ 31.7 mm (MNHN-Pa 1717). — Stn CH 133, 13°02'S, 48°02'E, 1000-1525 m, 21.01.1975: 1 ♂ 42.4 mm (MNHN-Pa 1608). — Stn CH 142, 13°45.6'S, 47°34.2'E, 1250-1300 m, 29.02.1975: 1 juv. (MNHN).

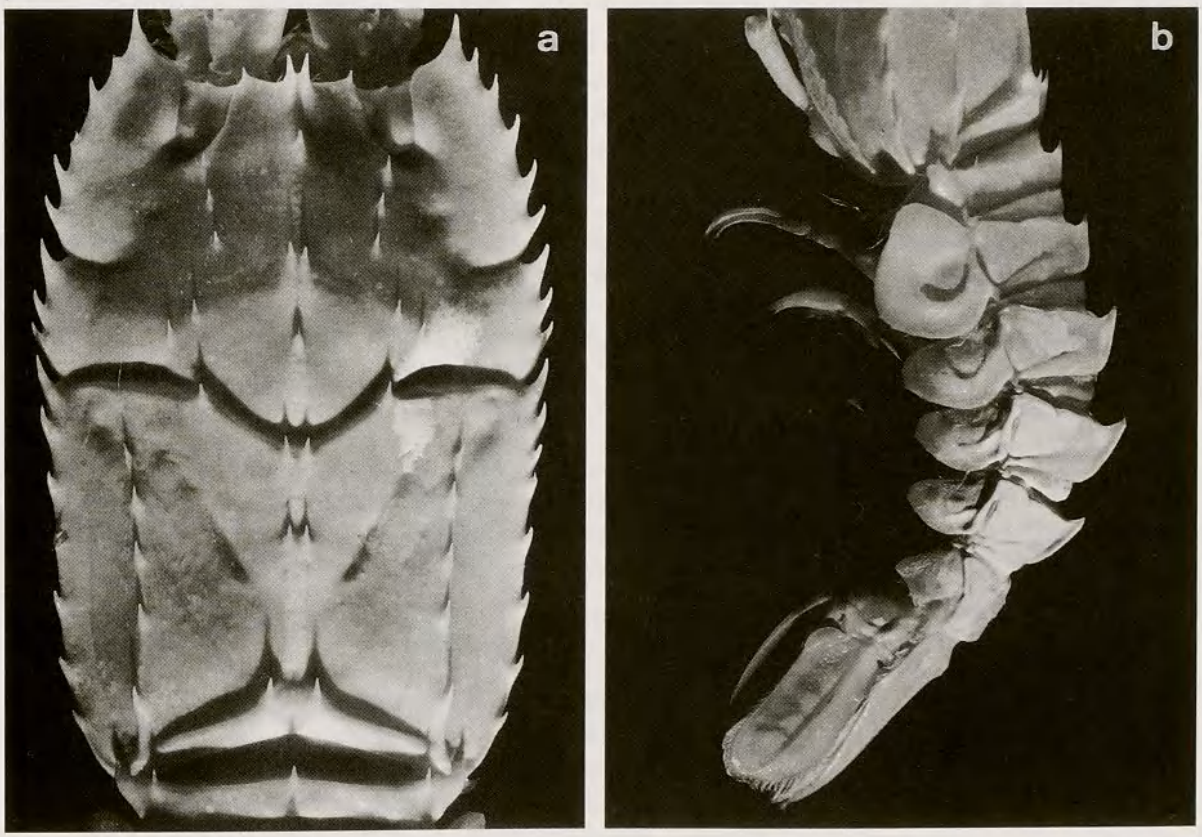

FIG. 24. — *Polycheles sculptus* Smith, 1880, ♂ 42.4 mm, Madagascar, 13°02'S, 48°02'E, 1000-1525 m (MNHN-Pa 1608): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

Source : MNHN, Paris

TYPE. — The male (38.2 mm cl) (USNM 39957) collected by the *"Epes Tarr"* off Nova Scotia, Canada (43°10'N, 61°20'W, 450 m) is the holotype of *Polycheles sculptus* Smith, 1880.

Four syntypes of *Pentacheles spinosus* A. Milne Edwards, 1880 are at the Museum of Comparative Zoology (Harvard) under the registration numbers MCZ 2794 (*"Blake"* stn 29, 2 specimens), MCZ 2795 (*"Blake"* stn 175, 1 specimen), MCZ 3076 (*"Blake"* stn 162, 1 specimen).

DESCRIPTION. — Dorsal surface of carapace setose, minutely granulate. Frontal margin straight, rostrum bifid. Internal angle of orbital sinus minutely spinose, external angle unarmed. Eyestalk bearing papilla, curved distad. Basal antennular segment produced anteriorly to a sharp point, mesial margin smooth, anterolateral margin bispinose. Spines on lateral margins of carapace upcurved, anteriormost largest. Spine formula of lateral margins of carapace 5-7:3:6-7; spines successively further apart posteriorly. Spine formula of median postrostral carina (excluding rostral spines) 1:2:1; median postcervical carina bearing two pairs of spines. Gastro-orbital region with crescentic row of five antrorse spines, anteriormost largest. Anterior margin of cervical groove with antrorse spine between median postcervical and branchial carinae. Branchial carina prominent, parallel to lateral margin, with 5-7 spines, posteriormost largest; region between branchial and median postcervical carinae unarmed, obliquely grooved anteriorly. Posterior margin of carapace bearing pair of antrorse submedian spines.

First abdominal tergite bearing two pairs of prominent spines laterally on anterior margin. Abdominal tergites medially carinate. Carinae on tergites 1-5 bearing antrorse spines, spines 1-4 increasing in size posteriorly; antrorse spine on fifth tergite smaller than fourth. Sixth tergite bearing mesially parallel pair of rounded carinae, confluent posteriorly. Tergites 2-5 with transversely oblique submedian grooves. Pleura 2-5 with curved rib mesially, margins minutely granulate. Anterior margin of second pleuron produced, triangulate. Telson with median crest anteriorly, two minutely serrulate, convergent carinae posteriorly.

Merus of P1 proximally bispinose, claw-like spine subterminally on upper margin, finely spinulose on lower margin; carpus half as long as merus with subterminal spines on upper and lower margins; upper margin of propodus with subterminal spine, lower margin with two minutely spinulate rows. P5 subchelate in male, chelate in female.

Color. — "rosy pink" (ALCOCK, 1901b: 171). In BOUVIER's color plate of *P. sculptus* (1917, pl. 3 fig. 1) the carapace and abdomen of *P. sculptus* are ivory colored with spines, tail fan, antennae and legs light orange red. BOUVIER (1925: 439) described it as "rouge rose presque uniforme".

REMARKS. — SMITH's description of *P. sculptus* (1880a, 1882) is both detailed and meticulous. A. MILNE EDWARDS' (1880) description of *Pentacheles spinosus*, though brief, allowed ALCOCK (1901b) to synonymize it with *sculptus*.

The "magnificent specimen of that strange blind crustacean" collected in the Mediterranean and described by GIGLIOLI (1881: 358) as differing "only in one or two minor details, which may be sexual differences" from *Willemoesia leptodactyla*, is in fact *P. sculptus*.

DISTRIBUTION. — Worldwide: Mediterranean, Ibero-Moroccan Gulf, Canary Is, Mauritania, Cape Verde Is, West Africa, South Africa, Labrador Sea, Iceland, Canada (Nova Scotia), United States, Gulf of Mexico, Caribbean Sea, Guyana, Chile, New Zealand, Tasman Sea,Vanuatu, Australia, Japan, China Sea, Philippines, Indonesia, Malay Archipelago, Ceylon, Arabian Sea, Gulf of Aden, Comoro Is, Madagascar, East Africa; 200 m (present work) - 4000 m (STEPHENSEN, 1923).

Polycheles suhmi (Bate, 1878)

Fig. 25

Pentacheles suhmi Bate, 1878a: 278; 1878b: 484; 1878c: 563. — NORMAN, 1879: 180. — HOLTHUIS, 1962: 183. — CHINA, 1964: 111.

Stereomastis suhmi - BATE, 1888: 154, figs 13, 37-38, pl. 15 figs 3-4. — STEBBING, 1893: 200. — DE MAN, 1916: 5 (list). — SUND, 1920: 223. — CALMAN, 1925: 19. — BARNARD, 1950: 574, fig. 105f. — HOLTHUIS, 1952a: 78. —

Source : MNHN, Paris

BERNARD, 1953: 87. — BAHAMONDE, 1963: 4. — ZARENKOV, 1964: 8; 1969: 81. — FIRTH & PEQUEGNAT, 1971: 72. — RETAMAL, 1974: 6; 1981: 16. — BAEZ & ANDRADE, 1979: 225, pl.1 fig. 5. — ANDRADE & BAEZ, 1980: 262. — KENSLEY, 1981b: 29. — MACPHERSON, 1983: 48 fig. 27; 1984: 74; 1991: 405. — ANDRADE, 1986: 45, 50. — TAKEDA, 1990: 358. — TIEFENBACHER, 1994: 17, fig. 1. — GRIFFIN & STODDART, 1995: 249, figs 12-15. — DAWSON, 1997: 23.

Polycheles suhmi - BOUVIER, 1917: 35.

Steromastis suhmi - WICKSTEN, 1989: 304 [erroneous spelling].

MATERIAL EXAMINED. — **SE Atlantic**. Off Cape province. *"Africana"*: 32°50'S, 16°45'E, 495 m, 25.08.1988: 1 ov. ♀ 28.5 mm (SAM). — 29°50.0'S, 15°03.1'E, 345 m, 12.08.1989: 1 ♂ 18.7 mm; 1 ♀ 23.1 mm (SAM). — 30°05'S, 14°54.1'E, 465 m, 13.08.1989: 1 ♀ 27.0 mm (SAM). — 32°20.4'S, 16°31.7'E, 367 m, 14.01.1990: 1 ♂ 18.2 mm (SAM). — 34°14'S, 17°39'E, 419 m, 12.02.1992: 3 ov. ♀ 27.7-30.5 mm (SAM). — 34°34'S, 17°57'E, 438 m, 12.02.1992: 1 ov. ♀ 31.4 mm (SAM). — 31°20'S, 16°09'E, 462 m, 20.02.1992: 2 ♂ 20.5, 23.1 mm; 1 ♀ 31.2 mm; 1 ov. ♀ 26.5 mm (SAM). — 29°56'S, 14°51'E, 446 m, 22.02.1992: 1 ♂ 23.6 mm; 1 ov. ♀ 27.0 mm (SAM). — 34°12'S, 17°37'E, 416 m, 11.01.1995: 1 ♂ 25.1 mm; 2 ov. ♀ 28.6, 22.6 mm (SAM). — 31°45'S, 15°42'E, 468 m, 25.01.1995: 1 ♀ 27.3 mm; 2 ov. ♀ 26.7, 24.2 mm (SAM). — 35°14'S, 18°42'E, 424 m, 5.02.1996: 4 ♂ 21.2-26.0 mm; 4 ♀ 22.9-29.5 mm (SAM).

33°20'S, 17°32.48'E, 451 m, 10.03.1988, coll. & id. B. KENSLEY: 2 ♂ 18.7, 18.9 mm; 2 ♀ 20.3, 28.8 mm; 10 ov. ♀ 25.5-29.4 mm (USNM 235173).

Discovery Seamount. *"Prof. Mesyatsev"*: stn 154, 760 m, 10.12.1979, coll. M.V. BONDARENKO: 1 ♂ 18.3 mm; 2 ♀ 20.9, 20.1 mm (ZMMU).

Chile. *"Challenger"*: stn 305b, Gulf of Penas, 47°48'S, 74°46'W, 292 m, 1.01.1876: 1 ♂ 17.1 mm (NHM 1888.22). — Stn 311, 52°45'30"S, 73°46'W, 441 m, 11.01.1876: 5 ♂ 15.2-18.6 mm; 4 ♀ 17.3-22.3 mm (NHM 1888.22).

"Albatross": stn 2780, 53°01'S, 73°42'30"W, 664 m, 2.02.1888, id. W.L. SCHMITT: 4 ♂ 19.9-22.6 5 mm; 5 ♀ 17.2-32.4 mm (USNM 58641). — Stn 2781, 51°52'S, 73°41'W, 626 m, 4.02.1888, id. W.L. SCHMITT: 1 damaged (USNM 58642). — Stn 2782, 51°12'S, 74°13'05"W, 464 m, 6.02.1888, id. M.J. RATHBUN: 3 ♂ 21.1-23.6 mm; 4 ♀ 22.7-37.7 mm; 1 juv. (USNM 28348). — Stn 2784, 48°41'S, 74°24'W, 349 m, 8.02.1888, id. M.J. RATHBUN: 2 ♂ 19.5, 26.8 mm; 3 ♀ 28.8-29.3 mm; 1 ov. ♀ 26.6 mm (USNM 28349). — Stn 2785, 48°09'S, 74°36'W, 808 m, 8.02.1888, id. M.J. RATHBUN: 1 ♀ 19.3 mm (USNM 58643).

Valparaiso. 10.02.1956: 2 ov. ♀ 24.5, 20.6 mm (USNM 99776); 1 ♂ 21.3 mm (RMNH).

"Eltanin": stn 1605, 52°53'S, 74°05'W, 522-544 m, 1.04.1966: 1 ♂ 22.1 mm; 1 ♀ 27.1 mm; 1 ov. ♀ 27.7 mm (USNM).

"Anton Bruun": stn 687, 34°07'S, 72°19'W, 750-730 m, 5.08.1966: 1 ♀ 21.3 mm (USNM).

New Zealand. NZOI: stn E747, 40°43.2'S, 176°48.4'E, 548-563 m, 29.03.1967: 1 ♀ 34.6 mm (NIWA). — Stn P120, 35°45.7'S, 165°04.1'E, 950 m, 3.06.1977: 1 juv. (NIWA). — Stn 1699, 48°16.0'S, 179°E, 532 m, 19.03.1979: 1 ♀ 20.1 mm; 2 juvs (NIWA). — Stn P927, 40°50.1'S, 168°14.8'E, 1009-1005 m, 18.04.1980: 1 ♂ 25.9 mm (NIWA) — Stn T33, 48°30.2'S, 179°43.5'W, 721-725 m, 13.03.1981: 1 juv. (NIWA). — Stn V227, 39°33.9'S, 169°04.7'E, 604 m, 18.10.1982: 1 ♂ 15.4 mm (NIWA). — Stn V391, 42°49.97'S, 176°59.91'E, 476 m, 17.09.1989: 1 ♂ 19.3 mm (NIWA). — Stn X510, 42°56.29'S, 175°41.39'W, 856-860 m, 10.07.1994: 1 ♂ 19.2 mm (NIWA). — Stn Z8974, 37°01.29'S, 176°19.58'E, 566-578 m, 11.04.1996: 1 ♂ 22.9 mm (NIWA). — Stn Z8566, 43°04'S, 175°39'E, 460 m, 1.10.1996: 5 ♀ 35.2-39.0 mm (NIWA). — Stn Z8990, 37°31.70'S, 176°46.96'E, 523-527 m, 17.01.1998: 1 ♂ 25.1 mm (NIWA). — Stn Z9014, 36°54.78'S, 176°20.43'E, 588-599 m, 23.01.1998: 1 ♀ 19.8 mm (NIWA).

Tasman Sea. *"Galathea"*: stn 626, 42°10'S, 170°10'E, 610 m, 20.01.1952: 2 ♂ 16.8, 26.5 mm; 6 ♀ 17.9-31.1 mm (ZMC).

Australia. SE Port Hunter. *"Kapala"*: stn K77-23-10, 33°11'S, 152°24'E, 732 m, 7.12.1977, id. D.E. BROWN: 1 ♂ 26.8 mm; 1 ov. ♀ 30.8 mm (AM P26756). — Stn K87-23-03, 34°42'S, 151°16'E, 760-855 m, 3.12.1987, id. H.E. STODDART: 1 ♀ 37.4 mm (AM P38726).

TYPE. — The male (17.1 mm cl) (NHM 1888.22) collected by the *"Challenger"* at stn 305b in the Gulf of Penas (47°48'S, 74°46'W, 292 m), is the holotype.

DESCRIPTION. — Dorsal surface of carapace with short setae, minutely granulate. Anterior margin of carapace straight, two obliquely set rostral spines. Internal angle of orbital notch bearing spine, external angle unarmed. Eye stalk with short spine, curved distad. Mesial margin of basal antennular segment with 2-3 spines, antero-external angle bearing two long spines. Spines on lateral margins of carapace upcurved, diminishing in size posteriorly, spine formula 5-6:2-3:7-9. Spine formula of mid-dorsal carina (excluding rostral spines) 1:1:2:2:1 before cervical groove, 2,2,2 behind cervical groove. Posterior margin of cervical groove with three spines midway between

Source : MNHN, Paris

median, branchial carinae. Gastro-orbital region with quadrispinose row, anteriormost largest, followed by cluster of 5-6 spines. Superior branchial carina prominently spinose, 7 spines between median and branchial carinae. Posterior margin of carapace with pair of submedian spines.

Anterior margin of first abdominal tergite laterally with two pairs of prominent spines, antrorse median spine. Median carina on abdominal tergites 2-5 bicuspidate, anteriorly spinose; sixth tergite with prominently denticulate double carina joined posteriorly in larger denticle. Terga 2-5 bearing shallow oblique grooves on each side of median carina. Pleura with cresentic rib mesially, margins sparsely denticulate, ventrally acute. Anterior margin of second pleuron produced, bearing prominent spine. Telson with median denticulate crest anteriorly, serrulate carinae posteriorly.

Merus of P1 with single proximal spine and subterminal claw-like spine on upper margin, lower margin smooth. Carpus half as long as merus, subterminal spine on upper and lower margins. Margins of chela smooth. P5 subchelate in male, chelate in female.

Color. — "Carapace, abdominal segments and telson a uniform pale whitish pink; all spines of carapace and abdominal terga a darker rose pink. Endopods and inner three-quarters of exopods of uropods whitish (almost transparent), entire outer edge of exopods trimmed in dark rose pink. Ischium, anterior portion of merus and palm of propodus of cheliped pale, almost white; distal end of merus and carpus pale pink; fingers of cheliped also pale pink, fading to white at tips." (GRIFFIN & STODDART, 1995: 250).

REMARKS. — *P. suhmi* is easily distinguished from its congeners in having a cluster of 5 or 6 spinules posteriorly on the gastric region, bicuspid median carinae on the abdominal tergites 2-5, the posterior cusp more prominent on fourth and fifth tergites.

DISTRIBUTION. — Southern Ocean: South Africa, Chile, New Zealand, Australia; 292 (present work) - 2195 m (CALMAN, 1925).

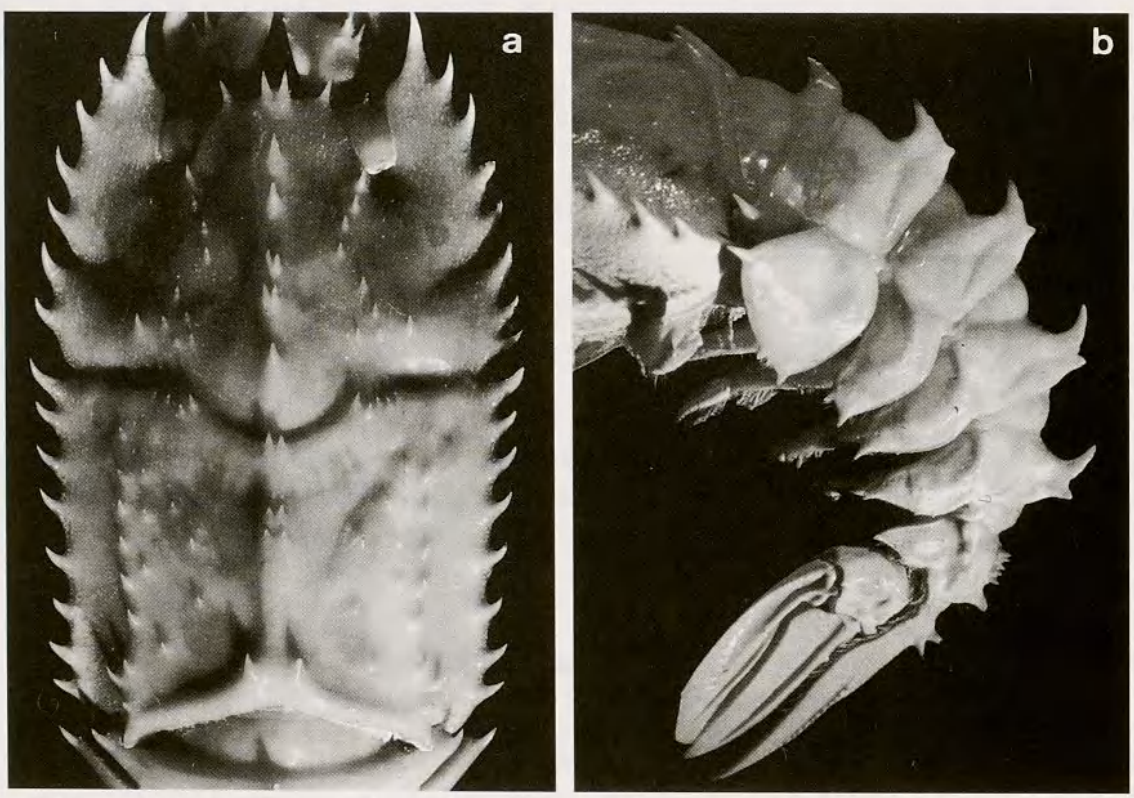

FIG. 25. — *Polycheles suhmi* (Bate, 1878): **a**, ♀ 31.2 mm, off Cape Province, *"Africana"*, 31°20'S, 16°09'E, 462 m (SAM), dorsal view of the cephalothorax; **b**, ♂ 26.5 mm, Tasman Sea, *"Galathea"* stn 626, 42°10'S, 170°10'E, 610 m (ZMC), lateral view of the abdomen.

Source : MNHN, Paris

Polycheles surdus sp. nov.

Fig. 26

Polycheles phosphorus RATHBUN, 1906: 898 [non Alcock, 1894].
Stereomastis phosphorus - GRIFFIN & STODDART, 1995: 246, figs 9-11 (p.p.).

MATERIAL EXAMINED. — **Southeast Pacific**. *Nazca Ridge. "Prof. Mesyatsev"*: 24°58'S, 88°28'W, 565 m, 1.09.1983: 2 ♀ 45.8, 55.7 mm (ZMMU).

"Prof. Stockman": stn 1964, 580-564 m, 30.04.1987: 3 ♂ 38.2-45.7 mm; 1 ov. ♀ 47.8 mm (ZMMU). — Stn 1965, 565-570 m, 30.04.1987: 1 ♂ 43.1 mm; 2 ♀ 43.3, 27.6 mm (ZMMU). — Stn 1971, 570-580 m, 1.05.1987: 2 ♂ 28.5, 39.4 mm; 1 ♀ 49.4 mm; 7 juvs (ZMMU). — Stn 1976, 569-590 m, 1.05.1987: 1 ♂ 38.2 mm; 1 ♀ 33.3 mm; 1 ov. ♀ 45.9 mm, 5 juvs (ZMMU). — Stn 1977, 545-600 m, 1-2.05.1987: 1 ♂ 28.8 mm; 4 juvs (ZMMU). — Stn 1996, 750-800 m, 5.05.1987: 2 ♂ 31.9, 39.9 mm; 1 ov. ♀ 52.0 mm; 1 juvs (ZMMU).

Sala-y-Gomez Ridge. "Prof. Stockman": stn 2018, 760 m, 7.05.1978,: 1 ♂ 44.8 mm; 1 ♀ 49.2 mm; 9 juvs (ZMMU). — Stn 2019, 25°05.6'S, 99°28.9'W, 750 m, 7.05.1978, colls MIRONOV & ZARENKOV: 1 ♀ 45.4 mm (ZMMU).

Marquesas Is. MUSORSTOM 9: stn CP 1191, 8°46.3'S, 140°07.2'W, 350 m 26.08.1997: 1 ov. ♀ 35.1 mm (MNHN-Pa 1688). — Stn CP 1271, 7°53.6'S, 140°42.2'W 600 m, 4.09.1997: 4 juvs (MNHN-Pa 1684). — Stn CP 1272, 7°55.5'S, 140°43.6'W 660-680 m, 4.09.1997: 1 ♂ 31.7 mm; 1 ov. ♀ 39.3 mm (MNHN-Pa 1683). — Stn CP 1276, 7°51.9'S, 140°38.2'W, 800-805 m, 5.09.1997: 3 juvs (MNHN-Pa 1685). — Stn CP 1278, 7°52.1'S, 140°38.6'W, 1000 m, 6.09.1997: 1 juv. (MNHN-Pa 1687). — Stn CP 1307, 8°57.9'S, 140°15.8'W, 708-738 m, 10.09.1997: 1 juv. (MNHN-Pa 1686).

Hawaii. *"Albatross"*(all the specimens identified as *P. phosphorus* by M.J. RATHBUN): stn 3467, Kauai Channel, 21°13'N, 157°43'37"W, 558 m, 3.12.1891: 1 ♀ 39.4 mm (USNM 30273). — Stn 3476, Kauai Channel, 21°09'N, 157°53'W, 536 m, 6.12.1891: 1 ♀ 43.6 mm (USNM 30274). — Stn 3816, Oahu I., surface, 29.03.1902: 1 ♂ 39.1 mm (USNM 30275). — Stn 3824, Molokai I., 400-880 m, 1.04.1902: 1 ov. ♀ 52.8 mm (USNM 30276). — Stn 3836, Molokai I., 428-459 m, 3.04.1902: 1 ♂ 38.5 mm (USNM 30277). — Stn 3839, Molokai I., 466-479 m, 4.04.1902: 1 ♂ 33.8 mm (USNM 30278). — Stn 3867, Pailolo Channel, 511-522 m, 10.04.1902: 1 ♂ 33.6 mm; 3 ♀ 31.1-58.0 mm (USNM 30282). — Stn 3883, Pailolo Channel, 499-511 m, 16.04.1902: 1 ♂ 38.0 mm (USNM 30283). — Stn 3884, Pailolo Channel, 511-522 m, 16.04.1902: 1 ♂ 47.6 mm (USNM 30284). — Stn 3907, Oahu I., Diamond Head, 547-567 m, 5.05.1902: 1 ♂ 39.4 mm (USNM 30286). — Stn 3910, Oahu I., Diamond Head, 560-607 m, 5.05.1902: 2 ♂ 37.0, 49.7 mm; 1 ♀ 39.9 mm (USNM 30287). — Stn 3911, Oahu I., Diamond Head, 601-607 m, 5.05.1902: 1 ♂ 43.1 mm (USNM 30288). — Stn 3917, Oahu I., Diamond Head, 529-594 m, 6.05.1902: 1 ♀ 26.8 mm (USNM 30289). — Stn 3920, Oahu I., Diamond Head, 477-504 m, 6.05.1902: 1 ♀ 39.4 mm (USNM 30290). — Stn 3988, Kauai I., 297-844 m, 11.06.1902: 1 ♂ 31.5 mm; 1 ♀ 48.6 mm (USNM 30296). — Stn 4028, Kauai I., 799-862 m, 24.06.1902: 1 ♂ 21.5 mm; 1 ♀ 46.0 mm (USNM 30300). — Stn 4097, Pailolo Channel, Mokuhooniki Islet, 515 m, 22.07.1902: 1 ♂ 43.7 mm (USNM 30285). — Stn 4187, Kauai I., 914-1265 m, 13.08.1902: 1 ♀ 41.2 mm (USNM 30314).

Banc Tuscarora. MUSORSTOM 7: stn CP 562, 11°48'S, 178°22'W, 775-777 m, 19.05.1992: 2 ♂ 49.0, 49.5 mm; 1 ♀ 45.1 mm (MNHN-Pa 1610). — Stn CC 550, 12°15'S, 177°28'W, 800-810 m, 18.05.1992: 1 ♀ 27.8 mm (MNHN-Pa 1718). — Stn CC 554, 12°14'S, 177°28'W, 795-820 m, 18.05.1992: 1 juv. (MNHN-Pa 1719). — Stn CP 567, 11°47'S, 178°27'W, 1010-1020 m, 20.05.1992: 1 juv. (MNHN-Pa 1720).

Banc Combe. MUSORSTOM 7: stn CC 553, 12°17'S, 177°28'W, 780-794 m, 18.05.1992: 2 ♂ 46.6, 34.7 mm; 1 ♀ 45.0 mm (MNHN-Pa 1609).

Banc Field. MUSORSTOM 7: stn CP 592, 12°32'S, 174°22'W, 730-775 m, 24.05.1992: 3 juvs (MNHN-Pa 1721).

Vanuatu. MUSORSTOM 8: stn CP 991, 18°51.26'S, 168°52.19'E, 936-910 m, 24.09.1994: 1 ♂ 29.4 m; 1 juv. (MNHN-Pa 1724). — Stn CP 996, 18°52'S, 168°56'E, 764-786 m, 24.09.1994: 1 juv. (MNHN-Pa 1725). — Stn CP 1008, 18°53.29'S, 168°52.65'E, 919-1000 m, 25.09.1994: 4 juvs (MNHN-Pa 1726). — Stn CC 1035, 17°58.02'S, 168°44.06'E, 765-780 m, 29.09.1994: 1 ♀ 44.7 mm (MNHN-Pa 1727).

New Caledonia. BIOGEOCAL: stn CP 290, 20°36.91'S, 167°03.34'E, 920-760 m, 27.04.1987: 1 ♀ 28.4 mm (MNHN-Pa 1746).

BATHUS 2: stn CP 751, 22°24.35'S, 166°12.83'E, 1300-1500m, 15.05.1993: 1 ♀ 26.8 mm (MNHN-Pa 1747). — Stn CP 765, 22°09'S, 166°02'E, 600-630 m, 17.05.1993: 1 ♂ 29.7 mm (MNHN-Pa 1722).

BATHUS 4: stn CP 950, 20°31.93'S, 164°56.11'E, 705-750 m, 10.08.1994: 1 ♂ 37.7 mm; 1 ♀ 54.6 mm (MNHN-Pa 1728).

New Zealand. NZOI: stn P927, 40°50.1'S, 168°14.8'E, 1009-1005 m, 18.04.1980: 1 juv. (NIWA). — Stn Z8256, 36°09.1'S, 176°15.5'E, 470 m, January 1994: 1 ♂ 25.6 mm (NIWA). — Stn Z8267, 36°49.7'S, 176°18.3'E, 510 m, December 1994: 1 ♀ 50.6 mm (NIWA). — Stn Z8268, 36°52.9'S, 176°19.1'E, 520 m, December 1994: 2 ♀ 43.1, 43.8 mm (NIWA). — Stn Z28996, 37°23.23'S, 176°32.85'E, 525-552 m, 19.01.1998: 1 ♀ 52.6 mm (NIWA). — Stn Z9007, 37°08.61'S, 176°19.64'E, 472-475 m, 21.01.1998: 2 ♂ 31.1, 30.3 mm; 1 ♀ 49.0 mm (NIWA). — Stn Z9008, 37°09.87'S, 176°21.74'E, 518-536 m, 22.01.1998: 1 ♂ 34.3 mm; 1 ♀ 29.2 mm (NIWA). — Stn Z9009,

Source : MNHN, Paris

37°13.40'S, 176°14.37'E, 224-264 m, 22.01.1998: 1 ♂ damaged (NIWA) — Stn Z9014, 36°54.78'S, 176°20.43'E, 588-599 m, 23.01.1998: 1 ♂ 32.4 mm (NIWA). — Stn Z9017, 36°46.53'S, 176°16.56'E, 465-474 m, 23.01.1998: 1 ♀ 41.8 mm (NIWA)

Australia. *New South Wales*. *"Kapala"*: stn K78-23-08, 28°03'S, 154°04'E, 732 m, 6.11.1978, id. H.E. STODDART as *Stereomastis phosphorus*: 1 ♂ 42.4 mm; 1 ♀ 49.4 mm (AM P44915).

Indonesia. Makassar Strait. CORINDON 2: stn 209, 00°07'S, 117°53'E, 490 m, 31.10.1980: 1 ♀ 45.9 mm (MNHN).

Indian Ocean. *Mascarene Ridge*."*Vitiaz*": stn 2817, 9°26'S, 60°05'E, 350-430 m, 10.01.1989: 1 ov. ♀ 45.0 mm (USNM). — Stn 2819, 8°48'S, 59°47'E, 525-530 m, 10.01.1989: 2 ♀ 27.3, 32.0 mm (USNM).

Reunion. *"Marion Dufresne"*: stn CP 113, 20°47.8'S, 55°08.5'E, 712-790 m, 31.08.1982: 2 ♂ 28.5, 40.0 mm (MNHN). — Stn CP 120, 20°54'S, 55°14.4'E, 940-1180 m, 31.08.1982: 1 ♂ 28.1 mm; 2 ♀ damaged (MNHN).

Madagascar. *"Vauban"* (coll. A. CROSNIER): stn 48, 15°18'S, 46°12.1'E, 480-510 m, 8.11.1972: 2 ♂ 32.6, 42.4 mm; 5 ♀ 46.6-56.7 mm (MNHN-Pa 1613). — Stn 59, 23°36'S, 43°29.6'E, 600-610 m, 27.02.1973: 1 ♂ 37.0 mm, 1 ♀ 50.9 mm (MNHN-Pa 1614). — No stn number, 21°17'S, 43°23'E, 490-530 m, 6.06.1973: 2 ♂ 32.0, 45.8 mm; 1 ♀ 53.5 mm (MNHN-Pa 1615). — Stn CH 133, 13°02'S, 48°02'E, 1000-1525 m, 21.01.1975: 3 juvs (MNHN-Pa 1612). — Stn CH 139, 13°50'S, 47°37'E, 850-1125 m, 27.02.1975: 4 juvs (MNHN-Pa 1616). — Stn CH 142, 13°45.6'S, 47°34.2'E, 1250-1300 m, 28.02.1975: 10 juvs (MNHN-Pa 1617).

"Mascareignes III"(coll. R. CLEVA): stn 5, 22°25'S, 43°04.8'E, 500-520 m, 21.12.1985: 3 ♂ 49.1-58.0 mm (MNHN-Pa 1145). — Stn 7, 22°26.1'S, 43°06.3'E, 400-425 m, 21-22.12.1985: 1 ♀ 50.4 mm (MNHN-Pa 1147). — Stn 9, 22°25.3'S, 43°04.9'E, 525-550 m, 22.12.1985: 3 ♀ 42.4-56.3 mm (MNHN-Pa 1148). — Stn 12, 22°23.5'S, 43°04.9'E, 400-425 m, 23.12.1985: 1 juv. (MNHN-Pa 1142). — Stn 25, 22°23.5'S, 43°05'E, 500-520 m, 15.01.1986: 3 ♂ 48.4-57.7 mm; 2 ♀ 31.1, 57.8 mm (MNHN-Pa 1144). — Stn 26, 22°18.7'S, 43°04.1'E, 450-600 m, 15.01.1986: 2 ♂ 43.0, 49.3 mm (MNHN-Pa 1143). — Stn 32, 22°25.8'S, 43°04.3'E, 450-475 m, 19.01.1986: 1 ♂ 52.7 mm (MNHN-Pa 1149).

"Mascareignes III"(coll. R. VON COSEL): stn CH 55, 22°17.2'S, 43°03.4'E, 430 m, 16.10.1986: 1 ♂ 50.7 mm (MNHN Pa 1618). — Stn CH 60, 22°25.6'S, 43°06.2'E, 475 m, 18.10.1986: 1 ♂ 50.9 mm (MNHN-Pa 1619). — Stn CH 63, 22°26.8'S, 43°05.4'E, 530 m, 20.10.1986: 1 ♂ 44.8 mm; 1 damaged (MNHN-Pa 1620). — Stn CH 113, 22°11.35'S, 43°02.3'E, 650 m, 27.11.1986: 5 juvs (MNHN-Pa 1621).

Mozambique Channel. *"Anton Bruun"*: stn 398, 22°25'S, 35°54'E, 740 m, 1.10.1964: 1 ♀ 26.9 mm (USNM).

Mozambique. *"Algoa"*: 18°14'S, 37°31'E, 472 m, 17.06.1994: 2 ♂ 39.5, 38.1 mm (SAM A41702); 1 ♀ 44.7 mm (SAM A41700). — 19°27'S, 36°51'E, 486 m, 14.06.1994: 1 ♀ 39.6 mm (SAM A41703). — 16°20'S, 40°08'E, 500 m, 16.06.1994: 1 ov. ♀ 51.8 mm (SAM A41701).

TYPES. — The male (39.5 mm cl) (SAM A41 702) collected off Mozambique (18°14'S, 37°31'E, 472 m) is the holotype; the smaller male from that sample is a paratype.

DESCRIPTION. — Carapace oblong, lateral margins subparallel, slightly convergent anteriorly. Dorsal surface of carapace tomentose, minutely granulose. Anterior margin of carapace straight. Median submarginal tooth upcurved, in front of bifid rostrum. Internal angle of orbital sinus unispinose, external angle unarmed. Eyestalk bearing mammilate spine, curved distad. Basal antennular segment produced anteriorly to a sharp point, mesial margin smooth; antero-external margin curved, bispinose, anterior spine longer than posterior. Spines formula of lateral margins of carapace 6-7:3-4:10-14; spines decreasing successively in size posteriorly. Spine formula of median postrostral carina (excluding rostral spines) 1:1:2:1; median postcervical carina bearing two pairs of spines. Posterior margin of cervical groove with 3 or 4 antrorse spines midway between median postcervical and branchial carinae. Gastro-orbital region bearing five spines in curved row. Branchial carina prominent, sinuous, bearing five spinules, posteriormost largest. Carapace between branchial and median carinae minutely granulate. Posterior margin of carapace bearing two prominent, antrorse submedian spines.

Anterior margin of first abdominal tergite bearing two pairs of lateral spines. Abdominal tergites medially carinate. Carinae of tergite 1-2 bearing small antrorse spine; carina of tergite 3 with a prominent, salient spine longer than the spine of the fourth; carina of tergite 5 simple. Sixth tergite bearing low, granulate, double carinae, confluent posteriorly in rounded knob. Tergites 2-5 with submedian grooves obsolescent. Pleura 2-4 with curved rib mesially. Margins of pleura denticulate; second pleuron anteriorly produced, ovate. Telson with short, denticulate crest anteriorly, two minutely serrulate submedian carinae posteriorly.

Merus of P1 bispinose proximally, claw-like spine subterminally on upper margin, occasionally spinulose on lower margin; carpus more than half as long as merus, with prominent spines subterminally on upper and lower margins. Upper margin of propodus nearly smooth. P5 subchelate in male, chelate in female.

Color. — "Dorsum pale opaque rose madder, darkest on abdomen; ridges of carapace opaque white; swimmerets, thoracic legs and mouth parts deeper madder yet still pink." (RATHBUN, 1906: 898).

Source : MNHN, Paris

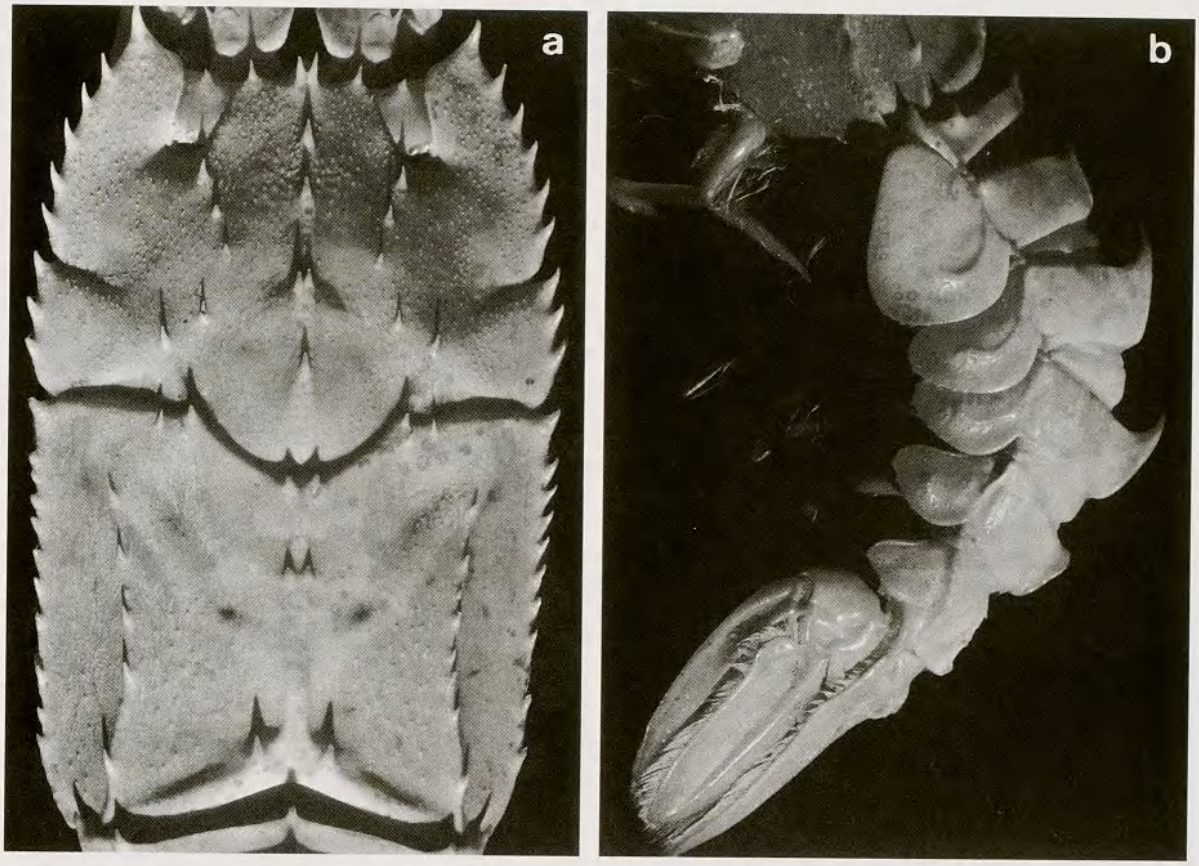

FIG. 26. — *Polycheles surdus* sp. nov., ♂ 38.4 mm, off Mozambique, *"Algoa"*, 18°14.0'S, 37°31.0'E, 472 m (SAM A41702): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

ETYMOLOGY. — From the Latin *surdus* (= deaf), refers to its relation to *auriculatus* (Bate, 1878).

REMARKS. — RATHBUN (1906: 898) observed that in her Hawaiian specimens "The lateral marginal spines of the carapace... are frequently seven in front of the first sinus, sometimes five between the sinus and the cervical groove, and behind the groove ther may be as many as ten". Indeed, the increased number of spines on the postcervical lateral margin distinguishes *surdus* from *auriculatus* (see above).

DISTRIBUTION. — Nazca Ridge in the southeast Pacific, Marquesas Is, Hawaii, New Caledonia, New Zealand, Australia, Indian Ocean, Reunion, Madagascar, Mozambique; 350-1525 m.

Polycheles talismani (Bouvier, 1917)

Fig. 27

Polycheles sculptus var. *talismani* Bouvier, 1917: 53.
Polycheles sculptus - BRUUN, 1950: 24, fig. 16 [non Smith, 1880].
Stereomastis sculpta - HOLTHUIS, 1952b: 11. — LONGHURST, 1958: 32. — FOREST, 1963: 627. — MACPHERSON, 1983: 48. — RUCABADO & BAS, 1984: 19 [not Smith, 1880].
Stereomastus sculpta - GAULD 1960: 63 [erroneous spelling] [non Smith, 1880].
Polycheles grimaldi - WOLFF, 1967: 236 (photo) [non Bouvier, 1905].
Stereomastis talismani - MACPHERSON, 1988: 57, fig. 5a; 1991: 405, fig.7. — DAWSON, 1997: 24.
Stereomastis sculpta talismani - HOLTHUIS, 1991: 88.

MATERIAL EXAMINED. — **West Africa**. CANCAP 3: 24°17'N, 16°52'W, 1100-1150 m, 26.10.1978: 1 ♂ 26.3 mm (RMNH).

Source : MNHN, Paris

"Talisman": stn 78, 23°57'N, 19°35'W, 1400-1435 m, 11.07.1883: 1 ♂ 28.1 mm; 1 ♀ 28.8 mm (MNHN-Pa 29). — Stn 93, 20°24'N, 20°28'W, 1435 m, 14.07.1883: 1 ♂ damaged (MNHN-Pa 28).

TYRO: stn 104, 19°43'N, 17°30'W, 1500 m, 17.06.1988: 1 ♀ 32.9 mm; 7 juvs (RMNH).

"Meteor": stn 192, 17°11.8'N, 16°50.6'W, 620 m, 11.02.1977: 1 ♀ (SMF 24644). — Stn 265, 17°17.1'N, 16°27.7'W, 95 m, 13.02.1982: 1 ♂, 1F (SMF 24643).

"Prof. Bogucki": stn 31, 15°02'N, 17°33'W, 807 m, 30.05.1979, coll. P. CAYRE: 1 ♂ 28.7 mm; 1 ♀ 35.1 mm (MNHN-Pa 655).

"Pillsbury": stn 41, 4°47'N, 3°33'W, 641-842 m, 30.05.1964: 11 ♂ 23.5-29.5 mm; 12 ♀ 26.2-47.8 mm (RMNH). — Stn 44, 5°05'N, 4°00'W, 586-403 m, 30.05.1964: 10 ♂ 24.5-30.1 mm; 9 ♀ 29.8-49.9 mm (RMNH). — Stn 51, 4°56'N, 4°01'W, 494-329m, 31.05.1964: 19 ♂ 23.5-30.1 mm; 21 ♀ 27.9-40.2 mm (RMNH). — Stn 52, 4°54'N, 4°58'W, 952-915 m, 31.05.1964: 1 ♂ 27.9 mm (RMNH). — Stn 74, 4°20'N, 9°26'W, 733-641 m, 4.06.1994: 33 ♂ 24.6-28.0 mm; 94 ♀ 23.5-48.5 mm (RMNH). — Stn 256, 14.05.1965: 20 ♂ 24.1-26.1 mm; 26 ♀ 26.2-36.8 mm (RMNH). — Stn 309, 4°15'N, 4°27'E, 678-720 m, 26.05.1965: 1 ♂ 26.1 mm; 2 ♀ 27.1, 29.5 mm (RMNH).

"Atlantide": stn 120, 2°09'N, 9°27'E, 260-650 m, 1.03.1946: 21 ♂ 24.6-29.4 mm; 16 ♀ 26.8-50.1 mm (ZMC). — Stn 135, 7°55'S, 12°38'E, 235-460 m, 17.03.1946: 16 ♂ 23.7-28.3 mm; 26 ♀ 26.5-51.5 mm; 1 ov. ♀ 42.3 mm (ZMC).

"Galathea": stn 32, 4°05'N, 2°13'W, 2100 m, 20.11.1950: 3 ♂ 22.1-23.8 mm (ZMC). — Stn 101, 8°50'S, 12°32'E, 1000 m, 12.12.1950: 1 ♀ 47.7 mm (ZMC). — Stn 110, 12°05'S, 13°08'E, 1000 m, 19.12.1950: 2 ♂ 26.9, 27.0 mm; 4 ♀ 28.0-54.3 mm (ZMC).

GUINEAN TRAWLING SURVEY I (GTS I): *"Thierry"*: stn 18/6, 4°28'N, 8°28.5'W, 100 m, 31.10.1963: 1 ♂ 29.8 mm; 2 ♀ 28.9, 49.1 mm (USNM). — Stn 29/8, 4°13'N, 1°23'W, 380-535 m, 4.09.1963: 2 ♀ 43.5, 48.5 mm (USNM). — Stn 34/8, 5°57'N, 1°33'W, 400 m, 23.02.1964: 3 ♀ 33.5-51.2 mm (USNM).

Stn 31/8, 5°06'N, 0°17'W, 400 m, 8.09.1963: 1 ♂ 28.1 mm; 3 ♀ 29.4-47.1 mm (MNHN-Pa 1622). — Stn 34/8, 5°57'N, 1°34'E, 370 m, 2.10.1963: 1 ♀ 29.0 mm (MNHN-Pa 1623). — Stn 36/8, 6°08'N, 2°56'E, 350-600 m, 6.10.1963: 1 ♀ 39.2 mm (MNHN-Pa 1624). — Stn 46/8, 3°45'N, 8°22'E, 425 m, 2.11.1963: 1 ♂ 28.0 mm (MNHN-Pa 1625). — Stn 59/8, 3°52'S, 10°14'E, 400 m, 2.12.1963: 3 ♀ 39.8-47.8 mm (MNHN-Pa 1116). — Stn 60/8, 4°25'S, 1°04'E, 400 m, 3.12.1968: 1 ♀ 41.2 mm (MNHN 1627).

GUINEAN TRAWLING SURVEY II (GTS II): stn 28/8, 4°21'N, 2°08'W, 400 m, 18.03.1963: 3 ♀ 26.6-42.9 mm (MNHN-Pa 562). — Stn 31/8, 5°05'N, 0°18'W, 400 m, 5.03.1964: 2 ♀ 33.0, 44.0 mm (MNHN-Pa 1628).

"André Nizery": stn 28, 1°51'S, 8°38'E, 950 m, 16.04.80: 4 ♀ 48.5- 58.7 mm (MNHN-Pa 530). — Stn 29, 1°55'S, 8°33.5'E, 1200-1430 m, 16.04.80: 2 ♀ 53.3, 57.8 mm (MNHN-Pa 533). — Stn 32, 2°41'S, 8°51'E, 900-930 m, 17.04.80: 2 ♀ 43.1, 43.2 mm (MNHN-Pa 528).

"Geronimo": stn 2-240, 4°08'S, 10°08'E, 1134 m, 8.09.1963: 1 ♀ 42.2 mm (MNHN-Pa 1108). — Stn 2-247, 4°38.4'S, 11°01.2'E, 402 m, 9.09.1963: 1 ♀ 43.9 mm (MNHN-Pa 1108).

TYPES. — The male (28.1 mm cl) (MNHN-Pa 29) collected by the *"Talisman"* stn 78 off West Africa (23°57'N, 19°35'W, 1400-1435 m), is the lectotype of *Polycheles talismani* Bouvier, 1917; the female in the same sample is the paralectotype.

DESCRIPTION. — Dorsal surface of carapace setose, minutely granulate. Frontal margin straight, rostrum bifid. Internal angle of orbital sinus minutely spinose, external angle unarmed. Eyestalk bearing papilla, curved distad. Basal antennular segment produced anteriorly to a sharp point, mesial margin smooth, anterolateral margin bispinose. Spines on lateral margins of carapace upcurved, anteriormost largest. Spines formula of lateral margins of carapace 5-6:3:8-10; spines successively further apart posteriorly. Spine formula of median postrostral carina (excluding rostral spines) 1:2:1, median postcervical carina bearing two pairs of spines. Gastro-orbital region with crescentic row of five antrorse spines, anteriormost largest. Posterior margin of cervical groove with antrorse spine between median postcervical and branchial carinae. Branchial carina prominent, parallel to lateral margin, with 5-7 spines, posteriormost largest; region between branchial and median carinae unarmed, obliquely grooved anteriorly. Posterior margin of carapace bearing pair of antrorse submedian spines.

First abdominal tergite bearing two pairs of prominent spines distally on anterior margin. Abdominal tergites medially carinate. Carinae on tergites 1-5 bearing antrorse spines, spines 1-4 increasing in size posteriorly; antrorse spine on fifth tergite smaller than on the fourth. Sixth tergite bearing lyre-shaped denticulate carina mesially. Tergites 2-5 with transversely oblique submedian grooves. Pleura 2-5 with curved rib mesially, margins minutely granulate. Anterior margin of second pleuron produced, triangulate. Telson with procumbent crest anteriorly, two minutely serrulate, convergent carinae posteriorly.

Merus of P1 proximally bispinose, with subterminal claw-like spine on upper margin, finely spinulose on lower margin; carpus half as long as merus, subterminal spines on upper and lower margins. Upper margin of

Source : MNHN, Paris

propodus with subterminal spine, lower margin with two minutely spinulate rows. P5 subchelate in male, chelate in female.

Color. — Carapace pale pink anterior to cervical groove, spines red, abdomen pale pink carinae, uropods dark red, legs red, antennae and antennulae red (HOLTHUIS, pers. obs.).

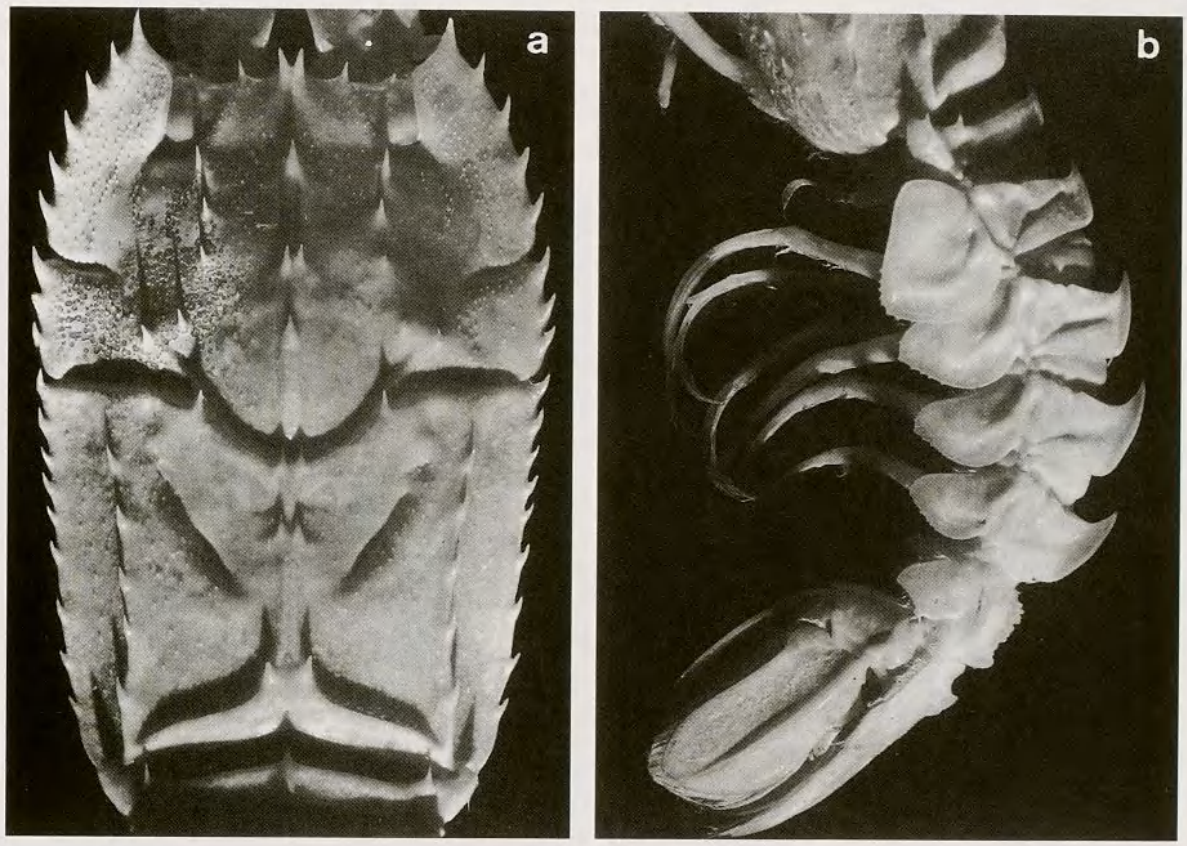

FIG. 27. — *Polycheles talismani* (Bouvier, 1917), ♀ 35.1 mm, Senegal, *"Prof. Bogucki"*, stn 31, 15°02'N, 17°33'W, 807 m (MNHN-Pa 655): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

REMARKS. — *P. talismani* is distinguished from *P. sculptus* in having 8-10 spines on the lateral margins of carapace posterior to postcervical incision rather than 6 or 7; the sixth tergal carina denticulate and lyre-shaped rather than parallel and rounded; and the median crest on telson prominent, keel-like, rather than rounded.

BOUVIER (1917: 53) offered but a cryptic description of *Polycheles sculptus* var. *talismani* "qui habite...d'Atlantique oriental". HOLTHUIS (1952: 11) noticed that his West African specimens differed in the number of spines on the lateral margin of the carapace from the North Atlantic *sculptus*. MACPHERSON (1988), examined BOUVIER's specimens and finding that they differed from *sculptus* in the number of lateral spines of the carapace, and the median dorsal keels on the sixth abdominal segment, assigned them specific status.

DISTRIBUTION. — West Africa: Mauritania to Angola; 100-2100 m.

Polycheles tanneri Faxon, 1893

Fig. 28

Polycheles tanneri Faxon, 1893: 196; 1895: 119, pl. 31. — SEELIGER, 1901: 46. — BOUVIER, 1915: 2. — SUND, 1915: 372. — DE MAN, 1916: 6 (list). — BERNARD, 1953: 86. — FIRTH & PEQUEGNAT, 1971: 50. — DEL SOLAR, 1972: 11. — WICKSTEN, 1989: 303. — HENDRICKX, 1995: 156. — DAWSON, 1997: 12.

Source : MNHN, Paris

MATERIAL EXAMINED. — **Panama**. *"Albatross"*: stn 3354, 7°09'07"N, 80°50'W, 580 m, 23.02.1891, id. W. FAXON: 1 juv. (USNM 21068).

Galapagos Is. *"Albatross"*: stn 3402, San Cristobal I., 0°57'03"S, 89°03'30"W, 758 m, 28.03.1891, id. W. FAXON: 4 ♀ 19.6-25.9 mm (USNM 21069). — Stn 3409, 0°18'40"N, 90°34'W, 589 m, 3.04.1891: 1 ♀ 41.8 mm (USNM 21070). — Stn 4642, Hood I., 1°30'30"S, 89°35'W, 540 m, 7.11.1904: 1 juv. (USNM).

Ecuador.*"Albatross"*: stn 2792, 0°37'N, 81°00'W, 722 m, 2.03.1888, id. W.L. SCHMITT: 1 ♂ damaged; 7 juvs (USNM 58646).

Peru. S. of Mancora Bank, 700-830 m, 11.01.1971, coll. E.M. DEL SOLAR: 1 ♂ 31.7 mm; 1 ♀ 24.5 mm (RMNH 27349).

TYPE. — The female (41.8 mm cl) (USNM 21070) collected by the *"Albatross"* stn 3409 off the Galapagos Is (0°18'40"N, 90°34'W, 589 m) is the holotype of *Polycheles tanneri* Faxon, 1893.

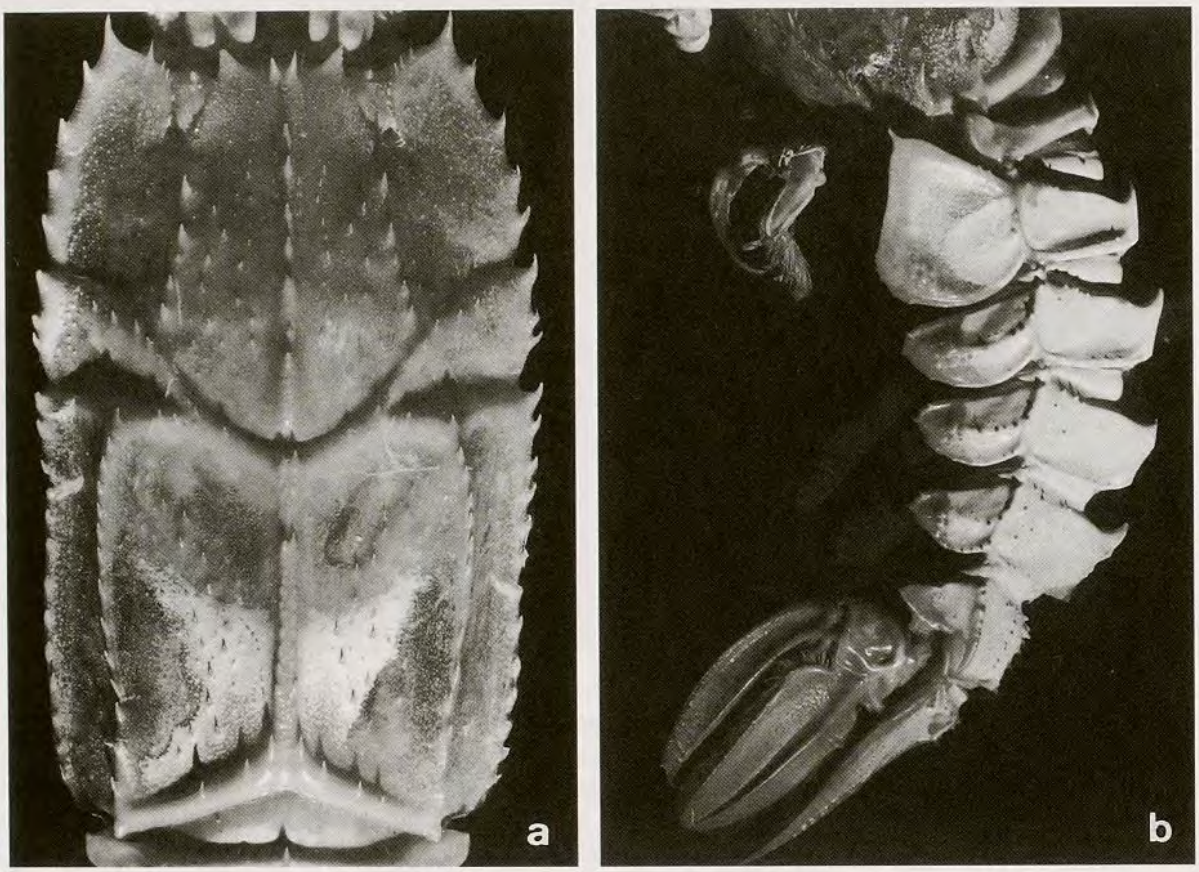

FIG. 28. — *Polycheles tanneri* Faxon, 1893, ♀ 41.8 mm, holotype, Galapagos Is, *"Albatross"* stn 3409, 0°18'40"N, 90°34'W, 589 m (USNM 21070): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

DESCRIPTION. — Dorsal surface of carapace tomentose, laterally granulose. Median submarginal tooth upcurved, reaching beyond twin rostral spines. Internal angle of orbital sinus pronounced, triangular; external angle convex, spinose, pectinate. Eyestalk distally granulose, bearing mammilate tubercle. Basal antennular segment produced anteriorly to a sharp point, mesial margin prominently spinulose; antero-external angle bispinose. Lateral spines diminishing in size posteriorly. Spine formula of lateral margins of carapace 5:3:13-14. Spine formula of median postrostral carina (excluding rostral spines) 1:1:1:(0-1):2:1; median postcervical carina bearing two pairs of spines. Gastro-orbital carina quadrispinose, anteriormost spine largest. Anterior branch of cervical carina spinulose. Posterior margin of cervical groove between median postcervical and branchial carinae spinose. Branchial carina prominent, bearing 13 or 14 antrorse spines. Carapace between gastro-orbital, branchial and median carinae with antrorse spinules. Posterior margin of carapace bearing antrorse spines, median pair largest.

Source : MNHN, Paris

First abdominal tergite with mammilate tubercle laterally. Abdominal tergites without oblique, submedian grooves, medially carinate. Tergites 1-5 bearing prominent, keel-like antrorse spine, spine of fourth tergite most prominent. Sixth tergite with conical tubercles, prominently granulate lateral margins, medially with two parallel rows of large conical granules meeting posterior margin in prominent denticle. Second pleuron furnished anteriorly with prominent spine. Pleura 3-5 with granulate rib mesially. Telson anteriorly with median denticulate crest, posteriorly with convergent, minutely serrulate carinae.

Merus of P1 spinulose on upper and lower margins, two distal claw-like spines on upper margin. Carpus one third as long as merus, distally spinose on upper margin, distal claw-like spine on upper and lower margins. Upper and lower margins of propodus prominently spinose. P5 simple in male, chelate in female.

REMARKS. — *P. tanneri* was described (1893), and not-quite-accurately illustrated (1895) by FAXON. *P. tanneri* is distinguished by its short cheliped carpus, the spinulose anterior branch of cervical carina and the prominent keel-like carinae on abdominal terga.

DISTRIBUTION. — Eastern Pacific: Panama, Ecuador, Peru and Galapagos Is; 540-830 m.

Polycheles trispinosus (De Man, 1905)

Fig. 29

Pentacheles trispinosus De Man, 1905: 587.
Stereomastis trispinosa - DE MAN, 1916: 10, pl. 1 figs 1, 1a-b. — BERNARD, 1953: 87. — FIRTH & PEQUEGNAT, 1971: 74. — MACPHERSON, 1991: 405. — TAKEDA & HANAMURA, 1994: 32.

MATERIAL EXAMINED. — **Indonesia**. *"Siboga"*: stn 38, 7°35.4'S, 117°28.6'E, 732-915 m, 1.04.1899: 1 ♂ 34.8 mm (ZMA); 1 ♀ 23.6 mm and 4 juvs (ZMA). — Stn 314, 7°36'S, 117°30.8'E, 694 m, 17.02.1900: 1 ♀ 34.0 mm; 7 juvs (ZMA).

SNELLIUS 2: stn 4267, 8°17.6'S, 118°21.3'E, 650 m, 29.10.1984: 6 ♂ 21.2-34.6 mm; 6 ♀ 21.4-35.2 mm; 1 juv. (RMNH).

TYPES. — The male (34.8 mm cl) (ZMA) collected by the *"Siboga"* stn 38 off Indonesia (7°35.4'S, 117°28.6'E, 732-915 m) is designated here as the lectotype; the female (23.6 mm cl) in the same sample is a paratype.

DESCRIPTION. — Carapace oblong, lateral margins subparallel, slightly convergent anteriorly. Dorsal surface of carapace tomentose. Frontal margin straight. Median submarginal tooth upcurved, in front of bifid rostrum. Internal angle of orbital sinus spinose, external angle unarmed. Eyestalk bearing mammilate tubercle, pointing distad. Basal antennular segment produced anteriorly to sharp point, mesial margin smooth; antero-external angle bispinose, anterior spine nearly twice as long as lateral. Spines of lateral margins of carapace decreasing successively in size posteriorly. Spine formula of lateral margins of carapace 5:3:9. Spine formula of median postrostral carina (excluding rostral spines) 1:1:2:1; median postcervical carina bearing two pairs of spines. Gastro-orbital region with row of five antrorse spines curved distad. Posterior margin of cervical groove with single prominent antrorse spine midway between median postrostral carina and lateral margin. Branchial carina slightly sinuous, bearing 11 spines. Carapace bearing 5 spines parallel with branchial groove; additional spine posteriorly, near branchial carina. Posterior margin of carapace bearing antrorse submedian spines.

Anterior margin of first abdominal tergite bearing two pairs of lateral spines. Carinae on tergites 1-3 bearing antrorse spine; spine of tergite 3 considerably longer, overhanging second tergite. Carinae on tergites 4-5 unarmed. Tergite 6 granulate, medially with denticulate double carina, confluent posteriorly. Tergites 2-5 with deep, transversely oblique, submedian grooves. Pleura 2-5 granulate, with curved, granulate rib medially, margins denticulate. Second pleuron rounded, bearing spine anteriorly. Telson bituberculate anteriorly, two minutely serrulate, confluent carinae posteriorly.

Merus of P1 proximally bispinose, subterminal claw-like spine on upper margin, finely spinulose on lower margin. Carpus half as long as merus, subterminal spines on upper and lower margins. Upper margin of propodus with 6-7 spinules, lower margin finely spinulose distally. P5 subchelate in male, chelate in female.

Source : MNHN, Paris

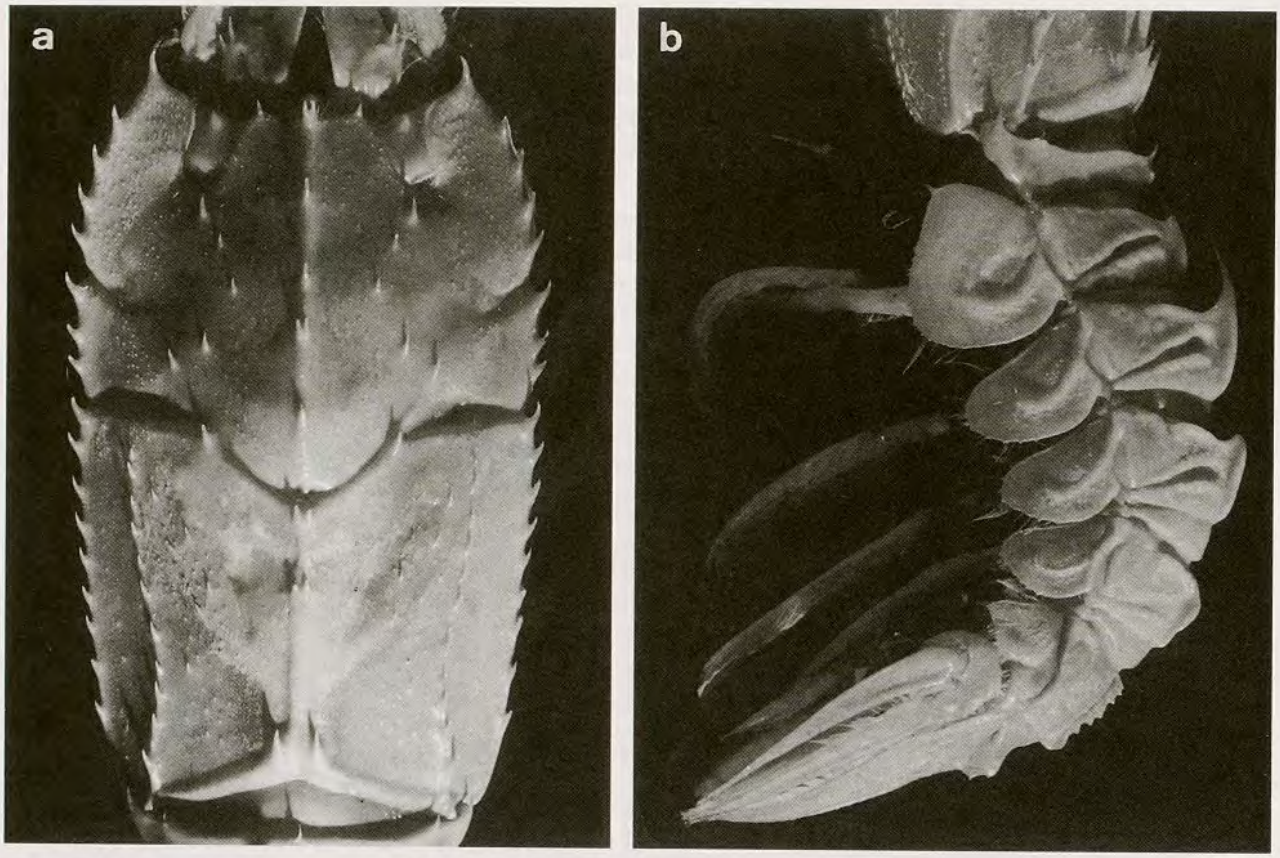

FIG. 29. — *Polycheles trispinosus* (de Man, 1905), ♀ 34.7 mm, Indonesia, SNELLIUS 2, stn 4267, 8°17.6'S, 118°21.3'E, 650 m (RMNH): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

REMARKS. — *Polycheles trispinosus* is distinguished from its congeners: "The carinae of only the three first abdominal terga are culminating in antrorse spine" (DE MAN, 1916: 10).

DISTRIBUTION. — Known only from Indonesia; 650-915 m (DE MAN, 1905).

Polycheles typhlops Heller, 1862

Fig. 30

Polycheles typhlops Heller, 1862: 392, pl. 1 figs 1-6; 1863: 211, pl. 7 figs 1-2. — CARPENTER & JEFFREYS, 1870: 154. — WOOD-MASON, 1874: 180; 1875: 134. — BATE, 1878a: 273; 1878c: 563; 1888: 100. — NORMAN, 1878: 382 (p.p.); 1879: 175 (p.p.); 1886: 7. — CARUS, 1885: 486. — STEINDACHNER, 1891: 438. — STEBBING, 1893: 200. — ADENSAMER, 1898: 621. — LO BIANCO, 1903: 250. — SENNA, 1903: 332, fig. 7, pl. 18 figs 1-11. — MAGRI, 1904: 7. — BOUVIER, 1905a: 480; 1905c: 3; 1915: 2; 1917: 35, pl. 2 figs 1-6; 1925: 433, fig. 9; 1940: 75, pl. 2. fig. 5. — KEMP, 1906: 7; 1910: 413. — RICHARD, 1907: 322. — PESTA, 1912: 103; 1918: 162, fig. 53. — KEMP & SEWELL, 1912: 24. — SELBIE, 1914: 12, pl. 1 figs 1-13. — SUND, 1915: 372. — H.C. WILLIAMSON, 1915: 437. — DE MAN, 1916: 6. — MIRANDA & RIVERA, 1921: 184; 1933: 18. — STEPHENSEN, 1923: 67. — BALSS, 1924: 179, figs 5, 8; 1925: 201, pl. 19. — CALMAN, 1925: 18. — DIEUZEIDE, 1929: 103; 1950: 46; 1960: 77. — BOLIVAR, 1930: 21, fig. 2. — SEURAT, 1930: 37; 1940: 145. — SANTUCCI, 1931: 1; 1932: 1; 1933: 1. — SCHMITT, 1935: 172. — ZARIQUIEY CENARRO, 1935: 6. — ZARIQUIEY ALVAREZ, 1946: 99, figs 123-124; 1955: 407; 1962: 30, 33; 1968: 209, fig. 86b. — VILELA, 1936: 224. — RAMADAN, 1938: 129. — PARENZAN, 1940: 139 (list). — LE DANOIS, 1948: 139, pl. 3. — BARNARD, 1950: 568. — TORTONESE, 1951: 220; 1958: 195; 1959: 448; 1962: 112; 1965: 85. — BERNARD, 1953: 86. — MARSHALL, 1954: 120. — PÉRÈS & PICARD, 1955: 51. — SEWELL, 1955: 203. — HOLTHUIS, 1956: 114; 1987: 297, fig. 2. — SPRINGER & BULLIS, 1956: 14 (p.p.). — DIEUZEIDE & ROLAND, 1957: 19; 1958: 23. — HEMMING, 1958: 137. — HOLTHUIS & GOTTLIEB, 1958: 114. — LONGHURST, 1958: 32. — ROSSI, 1958: 7. — FOREST & GANTES, 1960:

Source : MNHN, Paris

348. — RUSSELL, 1962: 6. — MAURIN, 1962: 180; 1968a: 45; 1968b: 479. — FOREST, 1963: 627; 1965: 346. — LEWINSOHN & HOLTHUIS, 1964: 54. — PÉRÈS, 1964: 22. — TORCHIO, 1964: 120; 1967: 122. — BULLIS & THOMPSON, 1965: 8. — DAWSON, 1965: 1. — GRINDLEY & PENRITH, 1965: 286. — KOTTHAUS, 1966: 348, figs 1-3. — ALLEN, 1967: 55. — MASSUTI, 1968: 306. — BERRY, 1969: 46. — STEVCIC, 1969: 128; 1990: 210. — CARPINE, 1970b: 135. — RUBIO LOIS, 1971: 10. — FIRTH & PEQUEGNAT, 1971: 50, figs 9-10. — PEQUEGNAT *et al.*, 1971: 4. — LAGARDÈRE, 1972: 672, fig. 5; 1977a: 399. — RELINI-ORSI & RELINI, 1972, fig. 5. — KOUKOURA, 1973: 753. — RELINI, 1973: 29. — NEVES, 1974: 7. — THIRIOT, 1974: 344. — PASTORE, 1976: 107. — TÜRKAY, 1976: 26; 1993: 284. — VOSS & JEUNIAUX, 1978: 127. — BEAUBRUN, 1979: 35, figs 15-16. — RODRIGUEZ, 1980: 194. — SOTO, 1980: 87. — BURKENROAD, 1981: 263. — MONCHARMONT, 1981: 66. — KENSLEY, 1981b: 29. — BURUKOVSKY, 1983: 134, fig. 178. — GEORGE, 1983: 16. — OHTA, 1983: 230. — RIEDL, 1983: 481, pl. 176. — TAKEDA, 1983: 74. — LEMAITRE, 1984: 427. — O'RIORDAN, 1984: 322. — OMORI, 1985: 63. — BABA, 1986: 157, pl. 107. — RELINI *et al.*, 1986: 156, tab. 4, fig. 4. — MANNING & FROGLIA, 1982: 321. — DURIS, 1987: 9. — GARCIA & MASSUDI, 1987: 75. — GONZALEZ-GURRIARAN & OLASO, 1987: 328 (list). — ABELLO & VALLADARES, 1988: 98. — ABELLO *et al.*, 1988: 41. — MORGAN & JONES, 1988: 15. — GONZALES *et al.*, 1988: 28. — CHAN & YU, 1989: 166, pl. 1; 1993: 105. — INTES & BACH, 1989: 21. — CARTES & ABELLO, 1990: 35; 1992: 139 . — FALCIAI & MINERVINI, 1992: 134, pl. 9, fig. 3. — CARTES & SARDA, 1992: 1315. — CARTES, 1993: 32. — CARTES *et al.*, 1993: 210. — EMMERSON, 1993: 181. — KOCATAS & KATAGAN, 1993: 35. — RODRIGUEZ, 1993: 197 (list). — VASO & GJIKNURI, 1993: 397. — PIPITONE & TAMBIOLO, 1993: 361 (list). — GALIL & GOREN, 1994: 45, fig. 2b. — QUACKENBUSH, 1994: 85. — GONZALEZ, 1995: 126, fig. 65.

Pentacheles agassizii A. Milne Edwards, 1880: 65. — FAXON, 1896: 155. — YOUNG, 1900: 441.

Polycheles doderleini Riggio, 1885: 103, pl. 3 figs 1-5.

Pentacheles hextii Alcock, 1894: 237; 1899: 35; 1901b: 172; 1902: 264. — ALCOCK & ANDERSON, 1894: 165; 1895, pl. 10 fig. 2.

Polycheles agassizii - FAXON, 1895: 120.

Polycheles agassizi - BOUVIER, 1905a: 480; 1905c: 3.

Polycheles hexti - BOUVIER, 1905a: 481.

Policheles typhlops - MAGRI, 1911: 32. — BOMBACE, 1968: 113. — RELINI-ORSI & RELINI, 1972: 59 [erroneous spelling].

Polycheles intermedius Balss, 1914: 599.

Polychelles typhlopis - NOBRE, 1931: 246, fig. 137; 1936: 153, pl. 51 fig. 130. [erroneous spelling].

Polycheles typhlops typhlops - FIRTH & PEQUEGNAT, 1971: 51, fig. 7. — WADLEY & EVANS, 1991: 27, pl. n.n. — GRIFFIN & STODDART, 1995: 242, figs 6-8. — TIEFENBACHER, 1995: 5. — DAWSON, 1997: 13.

Polycheles typhlos - ARENA & GRECI, 1973: 164 [erroneous spelling].

Polycheles thyphlos - ARENA & GRECI, 1973: 173. [erroneous spelling].

Polycheles tiphlops - FROGLIA, 1976: 78 (list) [erroneous spelling].

Polycheles sp. - GAMO, 1980, pl. 7b. — UTINOMI, 1983: 105.

Stereomastis nana - MIYAKE, 1982: 78, pl. 26 fig. 6 [non Smith, 1884].

Polycheles hextii - HOLTHUIS, 1984: 4.

Polycheles thyphlops - GONZALEZ-GURRIARAN & OLASO, 1987: 329. — JACQUES, 1989: 4. [erroneous spelling].

Polycheles typholps - MIYAKE, 1982, pl. 26 fig. 6. [erroneous spelling].

not *Polycheles typhrops* - TAKEDA, 1982, pl. 38.

MATERIAL EXAMINED. — **MEDITERRANEAN SEA**.

Israel. 32°31'N, 34°12'E, 1347-1500 m, 4-7.11.1998, coll. B. GALIL: 13 ♂ 18.3-37.6 mm; 16 ♀ 17.0-43.2 mm (TAU).

Spain. *Costa Brava*, 09.1960, id. L.B. HOLTHUIS: 1 ov. ♀ 33.2 mm (USNM 106118).

France. *Banyuls sur mer*, 1978: 1 ♀ (SMF 24637).

ATLANTIC OCEAN.

North Atlantic. 49°24.52'N, 11°29.14'W, 581 m, 20.07.1996: 1 ♂ 27.7 mm; 1 ♀ 25.9 m; 10 juvs (RMNH).

BALGIM: stn CP 124, 35°46'N, 3°52.'W, 1405 m, 14.06.1984: 2 ♀ 22.6, 37.1 mm (MNHN-Pa 1630).

West Africa. *"Meteor"*: stn M36-98 AT-149, 25°31.5'N, 16°02.2'W, 658-888 m, 24.02.1975: 8 spec. (SMF 24640). — Stn 180, 33°37.5'N, 9°02.2'W, 953-1038 m, 12.03.1975: 1 juv. (SMF 24641). — Stn M36-127 AT-261, 17°20.6'N, 16°27.1'W, 105 m, 10.02.1982: 10 spec. (SMF 24642).

"Talisman": Cape Verde, 16°52'N, 27°30'W, 400-580 m, 27.07.1883, det. E.L. BOUVIER: 1 ♂ 40.4 mm; 1 ♀ 48.4 mm (MNHN-Pa 1169).

"Pillsbury": stn 73, 4°40'N, 9°20'W, 366-311 m, 4.06.1964: 1 ♂ 32.0 mm (RMNH). — Stn 255, 3°49'N, 7°38'E, 269-264 m, 14.05.1965: 1 ♂ 35.5 mm (RMNH).

SE Atlantic. *"Prof. Mesyatsev"*: Rio Grande Ridge, 12.07.1974, coll. B.N. KOTENEV: 1 ♀ 38.8 mm (ZMMU).

Bermuda. E. St. Davids, 540 m, July-Aug. 1960: 1 ♀ damaged (USNM 106099).

United States. SE Cape Fear, 34°18'N, 75°51'W, 396 m, 14.06.1957, id. F.A. CHACE as *Stereomastis* nr *grimaldii*: 1 ♂ 29.8 mm (USNM 101642).

"Oregon": stn 5750, 29°33'N, 79°58'W, 556 m, 19.11.1965: 1 ♀ 26.7 mm (USNM 273140).

Source : MNHN, Paris

"Gerda": stn 67, 25°31'N, 79°57'W, 351 m, 26.09.1962: 1 ♀ 30.8 mm (RMNH).

West Indies. *"Blake"*: stn 246, 277 m, 1878-79: 1 ♀ 26.2 mm; 1 juv. (MNHN-Pa 32).

"Silver Bay": stn 2458, 23°40'N, 79°18'W, 522 m, 5.11.1960: 2 ♂ 23.5, 46.1 mm (USNM 273140). — Stn 2483, 26°25'N, 79°01'W, 540 m, 9.11.1960: 5 ♂ 29.7-33.3 mm; 2 ♀ 32.6, 51.3 mm (USNM 251943). — Stn 3472, 27°20'N, 78°19'W, 450-612 m, 25.10.1961: 1 ov. ♀ 34.9 mm (USNM 273140).

Gulf of Mexico. Dry Tortugas, 522 m, 3.07.1931, coll. & id. W.L. SCHMIDT: 4 ♂ 22.1-30.2 mm; 2 ♀ 23.6, 37.9 mm; 1 juv. (USNM 78283). — *Ibidem*, 448 m, 3.08.1932, coll. & id. W.L. SCHMIDT: 1 ♀ 37.0 mm (USNM 78260).

"Oregon": stn 489, 27°44'N, 85°09'W, 457 m, 29.09.1951: 1 ♀ damaged (USNM 92625). — Stn 1324, 24°23'N, 82°22'W, 360 m, 07.1955: 1 ♀ 48.5 mm (USNM 98652). — Stn 1407, 28°07'N, 89°59'W, 464 m, 20.09.1955: 1 ♂ 34.1 mm (USNM 99454). — Stn 3565, 14°10'N, 81°55'W, 432-450 m, 21.05.1962: 2 ♀ 38.6, 46.8 mm; 1 ov. ♀ 49.3 mm (USNM 244083). — Stn 3628, 16°57'N, 81°19'W, 450 m, 7.06.1962: 1 ♀ 43.4 mm (USNM 244083). — Stn 4337, 24°26'N, 83°23'W, 342 m, 26.07.1963: 1 ♀ 46.2 mm (USNM 273140). — Stn 4343, 24°33'N, 83°38'W, 378 m, 27.07.1963: 2 ♀ 28.4, 43.9 mm (USNM 273140). — Stn 4703, 27°55'N, 90°28'W, 540 m, 22.02.1964: 2 ♀ 32.3, 39.2 mm (USNM 273140) together with *P. perarmatus*. — Stn 5168, 29°23'N, 80°22'W, 43 m, 12.01.1965: 1 ♂ 40.9 mm (USNM 260368). — Stn 5233, 29°54.5'N, 80°10'W, 342 m, 9.02.1965: 1 ♀ 50.7 mm (USNM 273140).

Caribbean Sea. *"Albatross"*: stn 2134, 19°56'05"N, 75°47'32"W, 457 m, 27.02.1884: 1 ♂ 28.1 mm (USNM).

Puerto Rico. 18°32'N, 66°21.15'W, 468-648 m, 4.02.1933, id. W.L. SCHMITT: 2 ♂ 26.4, 27.2 mm; 4 juvs (USNM 82183).

"Silver Bay": stn 5142, 19°52'N, 71°58.5'W, 630 m, 12.10.1963: 1 ♂ 41.6 mm; 1 ♀ 29.9 mm (USNM 260368). — Stn 5166, 19°48.5'N, 70°30.5'W, 396-540 m, 15.10.1963: 2 ♂ 30.7, 38.1 mm; 1 ov. ♀ 36.1 mm (USNM 260368).

"Oregon": stn 2774, 11°32'N, 62°40'W, 351-382 m, 19.04.1960: 1 ov. ♀ 42.2 mm (USNM 232276) together with *P. perarmatus*. — Stn 2776, 11°36'N, 62°42'W, 423 m, 19.04.1960: 1 ♂ 40.7 mm; 1 ♀ 43.1 mm; 1 ov. ♀ 62.2 mm (USNM 232276). — Stn 2780, 11°36'N, 62°52'W, 387-414 m, 20.04.1960: 1 ♀ 41.5 mm (USNM 232276). — Stn 3552, 17°40'N, 77°55'W, 522 m, 16.05.1962, id. F.M. BAYER as *P. agassizii*: 2 ♀ 30.6, 40.5 mm (USNM 154322). — Stn 3570, 14°08'N, 81°55'W, 360-432 m, 05.1962, id. F.M. BAYER as *P. agassizii*: 1 ♂ 37.0 mm (USNM 154323). — Stn 3627, 16°50'N, 81°21'W, 360 m, 7.06.1962, id. F.M. BAYER as *P. agassizii*: 3 ♂ 28.9-40.2 mm; 1 ov. ♀ 43.0 mm (USNM 154397). — Stn 3635, 16°58'N, 87°53'W, 450-720 m, 10.06.1962, id. F.M. BAYER as *P. agassizii*: 1 ♀ 55.2 mm (USNM 154396). — Stn 4407, 11°59'N, 69°30'W, 414 m, 27.09.1963: 1 ♂ 32.7 mm; 2 ♀ 45.3, 50.8 mm (USNM 273140). — Stn 4411, 11°55'N, 69°27'W, 468 m, 3.10.1963: 2 ♀ 39.3, 44.0 mm (USNM 273140). — Stn 4417, 11°46'N, 69°15'W, 432 m, 4.10.1963: 1 ♂ 35.0 mm; 1 juv. (USNM 273140). — Stn 4419, 11°43'N, 69°13'W, 450 m, 4.10.1963: 1 ♂ 24.1 mm; 2 ♀ 40.7, 43.8 mm (USNM 273140). — Stn 4421, 11°49'N, 69°24'W, 360 m, 4.10.1963: 2 ♂ 32.3, 33.7 mm; 2 ♀ 27.1, 30.2 mm (USNM). — Stn 4424, 11°50'N, 69°23'W, 369 m, 5.10.1963: 1 ♀ 48.7 mm (USNM 273140). — Stn 4425, 11°46'N, 69°17'W, 432 m, 5.10.1963: 2 ♀ 49.7, 58.5 mm (USNM 273140).

"Pillsbury": stn 374, 9°57'N, 76°10.6'W, 439-377 m, 14.07.1966: 4 ♀ 46.1-52.3 mm; 2 juvs (RMNH). — Stn 394, 9°28.6'N, 76°26.3'W, 421-641 m, 16.07.1966: 1 ♀ 38.5 mm; 1 juv. (RMNH). — Stn 776, 12°13.3'N, 72°50'W, 408-576 m, 29.07.1968: 1 ♀ 40.4 mm; 9 juvs (RMNH). — Stn 929, 15°29.5'N, 61°11.5'W, 503 m, 15.07.1969: 1 ♂ 38.3 mm (RMNH).

INDO-WEST PACIFIC.

Fiji Is. MUSORSTOM 10: stn CP 1316, 17°14.84'S, 178°21.99'E, 478-490 m, 6.08.1998: 2 ♂ 38.5, 39.5 mm; 2 ov. ♀ 48.3, 47.2 mm (MNHN). — Stn CP 1331, 17°02.45'S, 178°01.84'E, 694-703 m, 8.08.1988: 14 ♂ 20.0-44.4 mm; 14 ♀ 20.7-37.7 mm; 7 juvs (MNHN). — Stn CP 1332, 16°56.17'S, 178°07.86'E, 640-687 m, 8.08.1998: 3 ♂ 24.9-6.8 mm; 4 ♀ 23.8-40.6 mm; 2 juvs (MNHN). — Stn CP 1368, 18°10.92'S, 178°23.47'E, 380-469 m, 15.08.1998: 1 ♀ 32.4 mm (MNHN). — Stn CP 1369, 18°11.13'S, 178°23.44'E, 392-433 m, 16.08.1998: 1 ♂ 39.7 mm; 2 ov. ♀ 4.32, 4.30 mm (MNHN).

New Caledonia. BATHUS 1: stn CP 671, 20°51.18'S, 165°28.17'E, 450-470 m, 14.03.1993: 1 ♀ 32.4 mm (MNHN-Pa 1730).

BATHUS 2: stn CP 760, 22°18.9'S, 166°10.5'E, 455 m, 16.05.1993: 1 ♀ 48.0 mm (MNHN-Pa 1631). — Stn CP 764, 22°09.41'S, 166°02.93'E, 560-570 m, 17.05.1993: 1 ♂ 43.1 mm (MNHN-Pa 1632). — Stn CP 765, 22°09.6'S, 166°02.8'E, 600-630 m, 17.05.1993: 1 ♂ 44.8 mm (MNHN-Pa 1633). — Stn CP 771, 22°09.52'S, 166°01.75'E, 610-800 m, 18.05.1993: 1 ♂ 50.5 mm (MNHN-Pa 1634).

Japan. Kyushu I., Miyazaki Pref., 300 m, 20.12.1953, det. S. MIYAKE as *P. amemiyai* Yokoya: 1 ♀ (KMNH 419). — Shikoku I., Tosa Bay, nr Mimase, 16.01-14.02.1961, coll. K. SAKAI: 2 ♀ (SMF 24638).

East China Sea. 20.10.1989, coll. M. YAMADA: 1 ♂ 54.0 mm (NFU).

Taiwan. I-Lan County, 400 m, 21.05.1992, coll. & det. T.Y. CHAN: 2 ♀ 34.6, 53.3 mm (NTOU). — Ta-Chi, 400 m, 13.06.1995, coll. & det. T.Y. CHAN: 4 ♀ 40.3-52.5 mm (MNHN-Pa 1682).

Philippines. *"Albatross"*: stn 5111, Luzon, 13°45'15"N, 120°46'30"E, 432 m, 16.01.1908: 1 ♂ 22.0 mm; 4 ♀ 16.0-37.5 mm (USNM). — Stn 5122, Mindoro, 13°21'30"N, 120°30'33"E, 402 m, 2.02.1908: 8 ♂ 21.1-26.6 mm; 7 ♀ 18.1-45.2 mm (USNM). — Stn 5123, Mindoro, 13°12'45"N, 121°38'45"E, 518 m, 2.02.1908: 1 ♂ 30.0 mm; 4 ♀ 34.6-43.8 mm (USNM). — Stn 5124, Mindoro, 12°52'N, 121°48'30"E, 514 m, 2.02.1908: 3 ♂ 27.5-29.7 mm; 4 ♀ 18.0-33.7 mm (USNM). — Stn 5221, btw Marinduque and Luzon, 13°38'15"N, 121°48'15"E, 357 m, 24.04.1908: 3 ♀ 41.8-

Source: MNHN, Paris

49.5 mm (USNM). — Stn 5222, btw Marinduque and Luzon, 13°38'30"N, 121°42'45"E, 357 m, 24.04.1908: 2 ♂ 28.6, 29.5 mm; 2 ♀ 20.9, 47.3 mm (USNM). — Stn 5364, Luzon, Balayan Bay, 13°48'30"N, 120°43'45"E, 293 m, 20.02.1909: 4 ♂ 32.0-34.1 mm; 5 ♀ 27.6-43.5 mm (USNM). — Stn 5374, Marinduque I., 13°46'45"N, 121°35'08"E, 347 m, 2.03.1909: 1 ♂ 31.2 mm; 2 ♀ 32.9, 36.0 mm (USNM). — Stn 5404, Leyte, Dupon Bay, 10°50'N, 124°26'18"E, 347 m, 17.03.1909: 1 ♀ 39.9 mm (USNM). — Stn 5409, btw Cebu and Leyte, 10°38'N, 124°13'08"E, 346 m, 18.03.1909: 2 ♀ 31.3, 31.9 mm (USNM).

MUSORSTOM 1: stn 50, 13°49.2'N, 120°01.8'E, 415-510 m, 25.03.1979: 1 ♂ 43.4 mm; 1 ♀ 56.5 mm (MNHN-Pa 1631).

MUSORSTOM 3: stn CP 105, 13°52'N, 120°30'E, 398-417 m, 1.06.1985: 1 ♂ 25.9 mm; 3 ♀ 26.1-38.0 mm (MNHN-Pa 1636). — Stn CP 118, 11°58'N, 121°06'E, 448-466 m, 3.06.1985: 1 ♂ 25.6 mm; 2 ♀ 44.2, 44.4 mm (MNHN-Pa 1637). — Stn CP 127, 11°48'N, 121°30'E, 464-475 m, 4.06.1985: 1 ♂ 41.3 mm; 3 ♀ 28.6-50.1 mm (MNHN-Pa 1638).

Indonesia. *"Albatross"*: stn 5622, btw Gillolo and Makyan Is, 0°19'20"N, 127°28'30"E, 503 m, 29.11.1909: 1 ♀ 50.2 mm; 2 ov. ♀ 49.0, 49.8 mm (USNM). — Stn 5624, btw Gillolo and Makyan Is, 0°12'15"N, 127°29'30"E, 518 m, 29.11.1909: 2 ♂ 37.2, 41.8 mm; 5 ♀ 24.0-63.1 mm; 1 ov. ♀ 49.8 mm (USNM). — Stn 5625, btw Gillolo and Kayoa Is, 0°07'00"N, 127°28'00"E, 421 m, 29.11.1909: 1 ♂ 25.8 mm; 1 ♀ 65.8 mm; 2 juvs (USNM). — Stn 5626, btw Gillolo and Kayoa Is, 0°07'30"N, 127°29'00"E, 485 m, 29.11.1909: 4 ♂ 18.5-29.1 mm; 5 ♀ 18.5-34.1 mm (USNM).

MORTENSEN EXPEDITION 1929: 8°30'S, 114°38'E, 450 m, 7.04.1929: 1 ♂ 31.7 mm (ZMC). — 7°29'S, 114°49'E, 240 m, 10.04.1929: 1 ♂ 24.8 mm (ZMC).

Java, 8°34'S, 114°36'E, 27.06.1981: 1 ov. ♀ 65.4 mm (USNM 356448).

KARUBAR. *Iles Kai*: stn CP 12, 5°23'S, 132°37'E, 436-413 m, 23.10.1991: 1 ♂ 44.8 mm (MNHN-Pa 1639). — Stn CP 35, 6°08'S, 132°45'E, 390-502 m, 27.10.1991: 1 ♀ 47.0 mm (MNHN-Pa 1640). — *Tanimbar Is*: stn CC 40, 7°46'S, 132°31'E, 443-468 m, 28.10.1991: 1 ♀ 56.1 mm (MNHN-Pa 1641).

Australia. *South East Coast. "Kapala":* stn K78-17-21, 28°37'S, 153°50'E, 502 m, 19.08.1978, id. H.E. STODDART, as *Polycheles typhlops typhlops:* 1 ♂ 43.8 mm (AM 44911). — Stn K84-15-02, 33°34'S, 151°57'E, 549-568 m, 10.09.1984, id. H.E. STODDART as *Polycheles typhlops typhlops:* 1 ♀ 37.6 mm (AM P39741).

North West Coast. "Solea": N.W.E. Cape Lambert, 18°32'S, 117°21'E, 496-504 m, 8.04.1982: 1 ♀ 46.3 mm (WAM C13427). — N.W. of Beagle Bay, 15°13.5'S, 121°08.9'E, 352 m, 11.02.1984: 1 ♂ 45.7 mm (WAM C16912). — 16°55.0'S, 119°54.0'E, 435-434 m, 18.02.1984: 1 ♂ 47.0 mm (WAM C23523). — 16°55.1'S, 119°55.1'E, 432-434 m, 19.02.1984: 1 ♀ 57.6 mm (WAM C23524). — 16°54.1'S, 119°55.6'E, 434 m, 21.02.1984: 1 ♀ 49.9 mm (WAM C23527). — W. of Lacepede Arch., 16°55.1'S, 119°54.8'E, 432-430 m, 22.02.1984: 1 ♂ 41.6 mm (WAM C23589). — W. Roebuck Bay, 18°04'S, 118°14'E, 400-396 m, 24.02.1984: 1 ♂ (WAM C23516). — 16°51'S, 119°48'E, 466-464 m, 28.02.1984: 1 ♀ 35.2 mm (WAM C23529).

"Courageous": N.W. of Port Hedland, 17°54'S, 118°28'E, 426-427 m, 21.08.1983: 1 ov. ♀ 57.2 mm (WAM C23597). — 17°28'S, 118°52'E, 428-433 m, 18.08.1983: 1 ♀ 60.0 mm (WAM C23599). — 18°54'S, 117°02'E, 300-306 m, 13.04.1984: 2 ♀ 49.1, 60.1 mm (WAM C13428). — 18°44'S, 116°59'E, 404-406 m, 23.08.1983: 1 ♂ 45.8 mm; 1 ♀ 60.6 mm (WAM C23522). — 18°05'S, 118°10'E, 401-400 m, 17.08.1983: 1 ♂ 38.9 mm; 1 ♀ 45.0 mm (WAM C23518).

Indian Ocean. 29°49.82'S, 41°39'E, 486 m, 1.06.1994, coll. S.I. LUSWAZI: 1 ♀ 56.1 mm (SAM).

Comoro Is. BENTHEDI: stn 61F, Mayotte, W de la grande passe de l'Ouest, 510-474 m, 29.03.1977: 2 ♂ 21.5, 27.5 mm; 2 ♀ 30.3, 38.5 mm (MNHN-Pa 1708). — Stn 114 F, 12°22.3'S, 46°28.2'E, 300-600 m, 11.04.1977: 1 ♂ 32.6 mm (MNHN-Pa 1710).

Madagascar. *"Vauban"*: stn CH 29, 12°43.1'S, 48°11.1'E, 540 m, 13.09.1972, coll. & det. A. CROSNIER: 1 ♂ 46.0 mm (MNHN-Pa 1642). — Stn 58, CH 23°36.2'S, 43°30.5'E, 510 m, 27.02.1973, coll. & det. A. CROSNIER: 1 ♂ 48.3 mm (MNHN-Pa 1643).

"Mascareignes III": stn 63, 22°26.8'S, 43°05.4'E, 530 m, 20.10.1986, coll. R. VON COSEL: 1 ♀ 72.4 mm (MNHN-Pa 1644). — Stn 68, 22°24.7'S, 43°04.4'E, 525 m, 21.10.1986, coll. R. VON COSEL: 1 ♂ 57.9 mm (MNHN-Pa 1645).

Mozambique. *"Algoa"*: 22°07'S, 35°45'E, 500 m, 9.06.1994: 1 ♂ 31.0 mm (SAM A41697). — 21°22'S, 35°40.E, 481 m, 13.06.1994: 3 ♂ 27.6-35.0 mm; 1 ♀ 25.3 mm (SAM A41698). — 17°33'S, 38°27'E, 433 m, 14.06.1994: 1 ov. ♀ 54.7 mm. — 19°27'S, 36°51'E, 486 m, 14.06.1994: 1 ♂ 30.6 mm; 1 ♀ damaged (SAM A41703). — 17°33.0'S, 38°27.0'E, 433 m, 15.06.1994: 1 ov. ♀ 54.3 mm (SAM A41704). — 16°20.0'S, 40°08.0'E, 500 m, 16.06.1994: 1 ov. ♀ 63.7 mm (SAM A41656). — 14°00'S, 37°31'E, 472 m, 17.06.1994: 1 ov. ♀ 51.6 mm; 1 ♀ 54.4 mm (SAM A41700). — 24°02'S, 35°45'E, 517 m, 20.06.1994: 1 ov. ♀ 47.4 mm; 1 ♀ 37.8 mm (SAM A41695). — Off Bazaruto I., 400-500 m, 19.06.1994: 2 ♂ 25.0, 35.2 mm (SAM A41699).

"Galathea": stn 202, 25°20'S, 35°17'E, 535-580 m, 21.02.1951: 1 ♀ 34.1 mm; 8 juvs (ZMC). — Stn 203, 25°20'S, 35°17'E, 680-730 m, 21.02.1951: 1 ♀ 26.6 mm (ZMC).

Kenya. Mombassa. 4°31.5'S, 39°42.5'E, 21.03.1981: 1 ♀ 40.3 mm (RMNH 34706).

Gulf of Aden. *"Meteor 5"*: stn 249, 12°29.5'N, 45°38.7'E, 1299-1314 m, 8.03.1987: 1 ♂ 24.9 mm; 1 ♀ 20.2 mm; 7 juvs (SMF 24654). — Stn 250, 12°40.4'N, 45°22.6'E, 907-917 m, 8.03.1987: 2 juvs (SMF 24655). — Stn 279, 12°52.5'N, 45°53.3'E, 1185-1186 m, 15.03.1987: 6 juvs (SMF 24656). — Stn 281, 12°38.5'N, 45°28.5'E, 1063-

Source : MNHN, Paris

1068 m, 15.03.1987: 1 juv. (SMF 24657). — Stn 286, 12°20.9'N, 44°44.7'E, 725-751 m, 16.03.1987: 1 ov. ♀ 31.1 mm; 1 juv. (SMF 24658).

TYPES. — The male (21.1 mm cl) (NHMW 9712) collected off Sicily by VON GROHMANN, is the holotype of *Polycheles typhlops* Heller, 1862.

The female (26.2 mm cl) (MNHN-Pa 32) collected by the *"Blake"* stn 246 off Grenada, is the holotype of *Pentacheles agassizii* A. Milne Edwards, 1880; the juvenile of the sample is the paratype. Other paratypes are at the Museum of Comparative Zoology under the registration numbers MCZ 2789 (*"Blake"* stn 216, 1 specimen), MCZ 2790 (*"Blake"* stn 47, 1 specimen), MCZ 2792, (*"Blake"* stn 274, 2 specimens, one broken), MCZ 3075 (*"Blake"* stn 285, 1 specimen), MCZ 4042 (*"Blake"* stn151, 1 male).

The largest male (80.0 mm total length) (IM 6767-6770/9 collected in the Andaman Sea by the *"Investigator"* stn 115 (11°31'40"N, 92°46'40"S, 344-402 m) is the lectotype of *Pentacheles hextii* Alcock, 1994; the other males and the single female of the sample are paralectotypes.

The female (40 mm cl) found at Palermo's fish market, and deposited in the Zoological Museum of Palermo (registration number C 44) is the holotype of *Polycheles doderleini* Riggio, 1895 (M. SARA, pers. comm.).

DESCRIPTION. — Dorsal surface of carapace setose, minutely spinulate, granulate. Frontal margin concave. Median submarginal tooth prominent. Single rostral spine antrorse. Internal angle of orbital sinus triangular, spinose; external angle of orbital sinus pectinate. Internal margin of orbit mesially pectinate, dividing orbit into two. Eyestalk bearing upcurved spine. Basal antennular segment produced anteriorly to a sharp point, mesial margin spinose, anterolateral margin rounded, bispinose. Spines on lateral margins of carapace upcurved; lateral spine formula 7-9:4-5:17-20; spines successively decrease in size posteriorly. Median postrostral carina granulate, irregularly spinulate, median postcervical carina bearing paired spinules. Gastro-orbital carina obsolescent, comprising five antrorse spines, anteriormost largest. Posterior margin of cervical groove spinose between branchial carinae. Branchial carina prominent, parallel with lateral margin, bearing 12-15 spines. Region between branchial and median postcervical carinae with shallow, oblique groove anteriorly, minutely spinulose posteriorly. Posterior margin of carapace bearing three or four pairs of antrorse spines, submedian spines largest.

Abdominal tergites medially carinate. Carinae on tergites 2-5 bearing antrorse spine, increasing in size posteriorly. Tergite 6 bearing mesially twin parallel rows of granules, confluent posteriorly. Anterior margin of first tergite smooth or granulate, never more than irregularly disposed 18 granules. Anterior and posterior margins of tergites 2-5 irregularly granulate. Second pleuron ovate, margins denticulate. Pleura 3-5 with curved granulate rib mesially, margins denticulate. Telson with granulate median crest anteriorly, two minutely serrulate, convergent carinae posteriorly. Inferior surface of uropodal expopod bicarinate.

Upper margin of merus of P1 spinulate with subterminal claw-like spine, lower margin finely granulose. Carpus half as long as merus, two serrulate rows distally on upper margin, subterminal spines on upper and lower margins. Upper margin of propodus with several rows of antrorse spinules, sometimes reduced to granules; lower margin with two minutely spinulate rows. P5 simple in male, chelate in female.

Color. — "Medial gastric and frontal region, scaphocerite and antennular peduncles, anterolateral edges and posterior border of carapace, cervical groove, mid-dorsal carina of carapace, carinae and granulate edges of abdominal terga bright orange. Remaining portions of carapace, abdominal terga and pleura white. Cheliped with proximal portion of merus white, distal third of merus and carpus orange. Upper surface of propodus and fingers orange, shading to pinkish white on underside and distal portions. All other pereopods white." (GRIFFIN & STODDART, 1995: 243). "Body ivory. Setae light brown. Ridges, margins, tips of spinules and granules on dorsal surface orange-red. Anteromedian carapace, tail-fan and pleopods marked with orange-red patches. Eggs whitish." (CHAN & YU, 1993: 106). Color photos in BABA (1986); CHAN & YU (1993); JONES & MORGAN (1994).

REMARKS. — HELLER (1862) described *Polycheles typhlops* from a single specimen collected off Sicily. Not only his description is remarkably accurate, but he realized its significance:"Die meiste Uebereinstimmung zeigt die Gattung noch mit dem von Desmarest beschrieben fossilen Krebse aus dem Solenhofer Kalkschiefer, eryon Cuvieri, indem auch bei diesem ein abgeflachter Cephalothorax, ahnlich gestalte Fuhler und Fusse sich vorfinden"

Source: MNHN, Paris

(HELLER, 1863: 211). WOOD-MASON (1874: 180) thought that:"a species differing in no particular of generic value from *Deidamia leptodactyla* et *crucifer*... had, years before, been described by Prof. C. Heller under the name of *Polycheles typhlops*". ADENSAMER (1898) went further and put *Willemoesia leptodactyla* in synonymy with *P. typhlops*.

A. MILNE EDWARDS (1880) described *Pentacheles agassizii* from the West Indies. BOUVIER (1905a: 480, footnote) compared "les types des *P. agassizi*, recueillis par le *"Blake"* avec un exemplaire de *P. typhlops* donné au Muséum par le Musée de Vienne" and considered them one species.

RIGGIO (1885: 101) described *Polycheles doderleini* from a specimen found in Palermo fish market, though aware of HELLER's opinion that "era certamente la femina del *Polycheles typhlops* da lui descritto".

ALCOCK (1894: 239) described *Polycheles hextii* quite accurately and noted "the peculiar formation of the ophthalmic notches, which superficially are divided into two portions by the meeting of the edges across the ophthalmic peduncle". BOUVIER (1905a: 481) recognized that "le *P. Hexti* Alc., présente les affinités les plus étroites avec notre *P. typhlops*", but KEMP and SEWELL (1912: 24) realized that they "correspond so precisely that the specific identity of the two forms cannot be doubted".

BALSS (1914: 599) described *Polycheles intermedius* and noted: "der frontal ist konkav; in seiner Mitte steht ein Rostraldorn". This species is without doubt a junior synonym of *P. typhlops*.

DISTRIBUTION. — Worldwide: Mediterranean, Irish Sea, Alboran Sea, West Africa, Cape Verde Is, Rio Grande Ridge, Bermuda, United States, West Indies, Gulf of Mexico, Caribbean Sea, New Caledonia, Australia, Japan, East China Sea,Taiwan, Philippines, Indonesia, Indian Ocean, Maldive Is, Comoro Is, Madagascar, South Africa, East Africa , Gulf of Aden; 77 m (present work) - 2055 m (ADENSAMER, 1898).

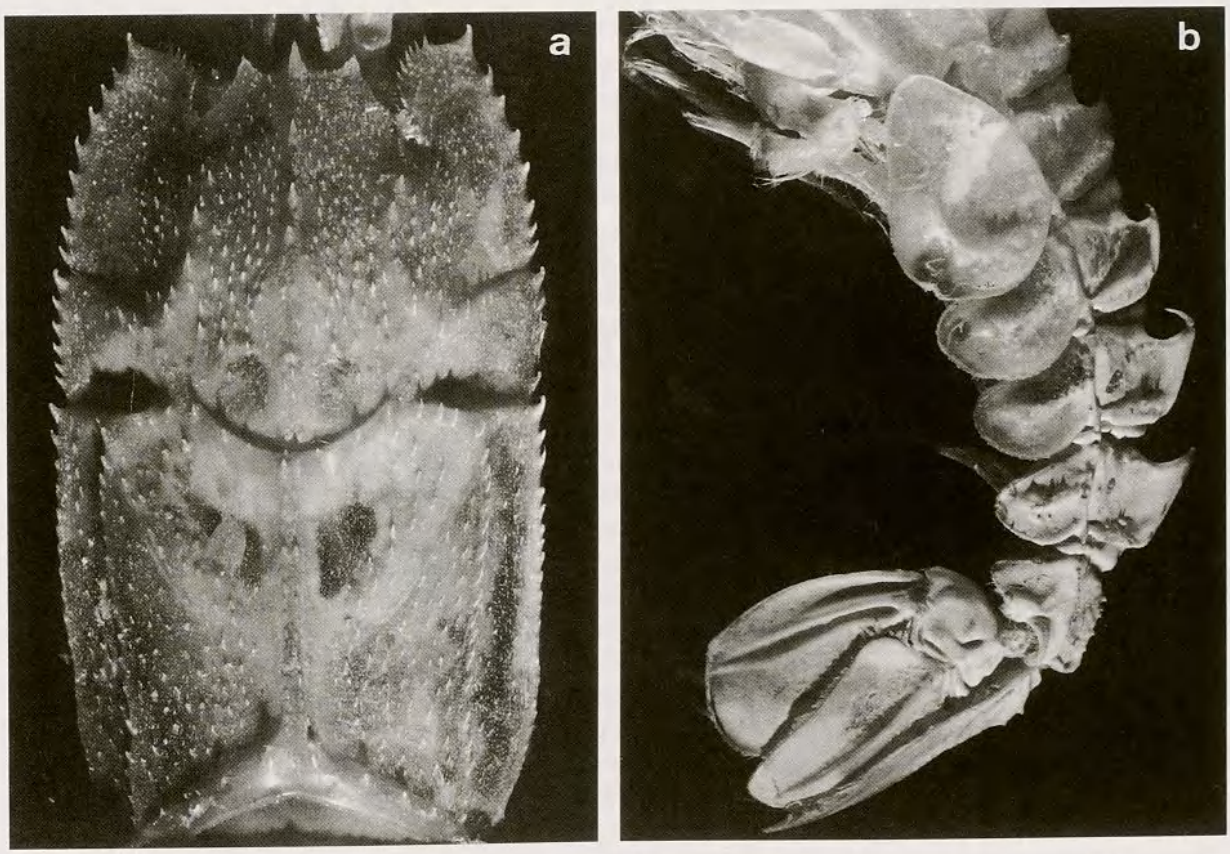

FIG. 30. — *Polycheles typhlops* Heller, 1862, ♀ 38.8 mm, Rio Grande Ridge, *"Prof. Mesyatsev"* (ZMMU): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

Source : MNHN, Paris

Genus *WILLEMOESIA* Grote, 1873

Willemoesia Grote, 1873: 485. Type species by monotypy through the replaced name *Deidamia* Thomson, 1873: *Deidamia leptodactyla* Thomson, 1873: 51. Placed on the Official List of Generic names in Zoology in Opinion 519 of the ICZN. Gender feminine.

Deidamia Thomson, 1873: 51. Type species by monotypy, *Deidamia leptodactyla* Thomson, 1878: 51. A junior homonym of *Deidamia* Clemens, 1859. Placed on the Official Index of rejected generic names in Zoology in Opinion 579 of the ICZN. Gender feminine.

DIAGNOSIS. — Carapace dorsoventrally flattened, subrectangular or ovate. Antero-lateral angle of carapace produced, spiniform. Lateral margins well defined, spinose; cervical and postcervical incisions dividing margin into three parts. Front bearing single rostral spine, lacking well defined orbits. Eyestalks globose, fixed beneath and parallel with anterior margin of carapace.

Cervical groove marked, arcuate, laterally bifurcate. Median postrostral and postcervical carinae well defined, unarmed, granulate or spinose. Gastro-orbital and branchial carinae present, obsolescent or well defined, unarmed, granulate or spinose. Two sublateral carinae starting near posterolateral margin of carapace, running to base of antenna and base of P1; latter more distinct.

Abdomen somewhat laterally depressed. First abdominal tergite narrow, pleura fused, abbreviated. Abdominal tergites 2-5 smooth or sculptured, medially carinate, carinae blunt or anteriorly spinose; sixth tergite smooth or sculptured. Second abdominal pleuron larger, clypeiform, smooth; pleura 3-4 cordiform, successively diminishing in size posteriorly; fifth pleuron triangulate. Abdominal sternites lacking median knob. Telson lanceolate, basally swollen; two submedian carinae. Uropodal exopod lamellar, posteriorly rounded, bicarinate; endopod unicarinate, lappet basally on interior margin.

Interior process of basal antennular segment lamellate, rounded, shorter than peduncle; mesial margin spinose, perpendicular to segment; anterolateral angle not spinose. Outer antennular flagellum short, inner flagellum as long as antennal flagellum. Renal process well developed, tubular, fitting into hollow on underside of basal antennular segment. Antennal scaphocerite not extending to end of peduncle.

Buccal opening subquadrate. Mandible concave, cutting edge with triangular teeth of uneven size, lateral, median teeth largest; mandibular palp biarticulate. Maxillula with two incurved lobes; anterior lobe more robust, terminating in cornute claw. Maxilla with two slender protognathal lobes of equal length; scaphognathite large, reniform, membraneous. First maxilliped endopod slender; exopodal lobe membraneous, extending further back than scaphognathite; exopod anteriorly divided into two lamellar lobes enclosing efferent passage. Second and third maxillipeds slender, pediform; interior margins of basal segments denticulate; dactyls ending in cornute claw; third maxilliped bearing long epipodite basally, cornute subterminal spines on interior margin of dactyl.

All pereiopods chelate in both sexes; fingers of fifth pereiopodal chela one sixth as long as propodus, whereas in preceding pereiopods fingers about half as long as propodus. P1 elongate, slender; P 2-5 successively shorter posteriorly. Fingers of first cheliped crossing, pollex bearing on inner margin subterminal spine at right angle to finger; inner margins of both pollex, dactyl furnished with row of overlapping cornute platelets, forming serrate edge. Fingers of second and third pereiopodal chelae crossing distally, their inner margins set with row of overlapping platelets; platelets not overlapping in fingers of fourth chela, missing entirely in fingers of fifth pereiopodal chela. First male pleopod oar-shaped, spinulose swelling distally on inner margin, spinules distally on mesial margin, distal margin folded internally. Pleopods 2-6 slender with rod-like appendix interna, second pair in male with appendix masculina.

REMARKS. — *Willemoesia* is distinguished from other polychelid genera in having the five pairs of pereiopods chelate in both sexes; lacking well defined orbits, its globose eyestalks fixed beneath and parallel with the anterior margin of the carapace; and the pollex of the first cheliped bearing on its inner margin a subterminal spine at right angle to the finger.

Nearly a century after it was established, it was felt that "a careful revision of the entire genus is badly needed" (WOLFF, 1961: 148). KENSLEY (1968: 297) considered the "Specific delimitation in this genus ... very difficult,

Source : MNHN, Paris

particularly as the number of specimens available is very low". GORE (1984: 1) declared that "Because the range of morphological variation within the genus *Willemoesia* is not yet known, owing to paucity of specimens in the 8 known species, the taxonomic validity of several species within the genus remains uncertain". Of the eight species described, only four are recognized as valid in this work.

Willemoesia forceps A. Milne Edwards, 1880

Fig. 31

Willemoesia forceps A. Milne Edwards, 1880: 64. — FAXON, 1895: 126. — BOUVIER, 1905a: 480 (p.p.); 1905c: 3 (p.p.); 1907: 62; 1917: 32, figs 1-4, pl. 10 figs 1-2, pl. 11 figs 1-6; 1925: 424. — DE MAN, 1916: 6 (list). — SIVERSTEN & HOLTHUIS, 1956: 41, figs 30-31. — FIRTH & PEQUEGNAT, 1971: 75, figs 3, 13. — PEQUEGNAT *et al.*, 1971: 4. — RODRIGUEZ, 1980: 194. — GORE, 1984: 2. — DAWSON, 1997: 25.
Willemoesia sp. - GAMO, 1980: 94, fig. 7a.
not *Willemoesia forceps* - ALCOCK, 1894: 230; 1899: 33; 1902: 155 [= *W. leptodactyla* (Willemoes-Suhm, 1875)].
not *Willemoesia forceps* - BERNARD, 1953: 88, fig. 36 [= *W. pacifica* Sund, 1920].

MATERIAL EXAMINED. — **West Africa**. *"Talisman"*: 29°01'N, 19°15'E, 2713 m, 10.07.1883: 1 ♂ 37.0 mm (MNHN).

"Pillsbury": stn 18, 5°01'N, 0°12'E, 3047-3129 m, 26.05.1964: 1 ♀ 77.8 mm (RMNH). — Stn 266, 1°12.5'N, 7°46'E, 2507-2562 m, 17.05.1965: 1 ♀ 71.8 mm (RMNH).

"Walda": 0°20.7'S, 5°48.4'E, 3244 m, 30.07.1971: 1 ♀ 74.7 mm (MNHN-Pa 537).

West Indies. *"Pillsbury"*: stn 1178, 19°14'N, 73°14'W, 1760 m, 30.06.1970: 1 ♂ 40.1 mm (RMNH).

"Iselin": stn 8, 21°34'N, 74°32'W, 2745 m, 18.11.1981: 1 ♂ 73.1 mm (USNM 347932). — Stn 5, 22°03'N, 74°48'W, 2728 m, 16.11.1981: 1 ♂ 60.0 mm (USNM 347932); 2 ♂ 46.6 59.8 mm (USNM 347932). — Stn 9, 21°27'N, 74°21'W, 2714 m, 18.11.1981: 1 ♀ 40.7 mm (USNM 347932).

Caribbean Sea. *"Pillsbury"*: stn 748, 11°24.8'N, 67°10.1'W, 1878-1784 m, 25.07.1968: 1 juv. (RMNH).

Venezuela Basin, *"Bartlett"* (id. R.H. GORE): stn 39, 15°08.93'N, 69°13.33'W, 3977-4047 m, 27-28.10.1981: 1 juv. 33.2 mm (NHM 1984:54). — Stn 93, 13°32.18'N, 64°40.54'W, 3406-3453 m, 28.11.1981: 1 ♀ 52.7 mm (USNM 210820). — Stn 94, 13°32.2'N, 64°42'W, 3427-3475 m, 28-29.11.1981: 2 ♀ 67.7, 80.8 mm (RMNH 35840).

TYPE. — The female (72 mm total length) (MCZ 4045) collected by the *"Blake"* stn 31 off Santa Cruz, Cuba (24°33'N, 84°23'W, 3512 m) is the holotype.

DESCRIPTION. — Dorsal surface of carapace nearly glabrous, densely set with antrorse spinules. Rostral spine upcurved. Frontal margin of carapace concave, external angles produced, spinose. Eyestalk globose, bearing spine curved distad. Mesial margin of basal segment of antennule prominently spinose, pectinate. Lateral margin of carapace spinose; spine formula 14-19:14-15:29-40. Median postrostral carina granulose, bearing pair of larger spinules 2/3 way to cervical groove, followed by single spine. Median postcervical carina granulate, bearing larger antrorse spines posteriorly. Gastro-orbital carinae sinuous, minutely spinulate. Branchial carina prominent, spinose. Posterior margin of carapace smooth.

First abdominal tergite tuberculate medially. Median dorsal carina on tergites 2-4 bearing antrorse spine. Fifth carina blunt. Sixth tergite smooth, medially on posterior margin slight hump. Tergites 2-5 bearing well-defined, submedian transverse groove. Second pleuron subcircular, smooth. Pleura 3-5 with obsolescent rib mesially, margins unarmed. Telson with triangular hump anteriorly, smooth convergent carinae posteriorly. Margin of uropodal endopod triangular.

First chelipeds thin, elongate; upper margin of merus minutely spinose, two claw-like spines subterminally, lower margin prominently spinose; carpus 4/5 as long as merus, wider distally, spinose on upper margin. Upper margin of chela bearing several irregular files of spines; lower margin bearing two files, spines of interior file longer; single file along lower margin of finger.

Color. — "deep brick red overall, more brownish-red on cephalothorax, brighter red on abdominal somites. Telson and uropods almost cherry red. Antennae and antennulae deep scarlet, including flagella. Pereiopods brick red, tending toward orange-red distally. Long bunched setae and hairs ornamenting carapace ranging from pale to golden yellow." (GORE, 1984: 3).

Source : MNHN, Paris

REMARKS. — *W. forceps* differs from the other three species of the genus in having the most spines along the lateral margins of carapace, and a smooth sixth abdominal tergite except for a blunt median carina posteriorly.

DISTRIBUTION. — West Africa, Azores, Saragasso Sea, West Indies, Caribbean Sea; 1760 m (present work) - 4064 m (GORE, 1984).

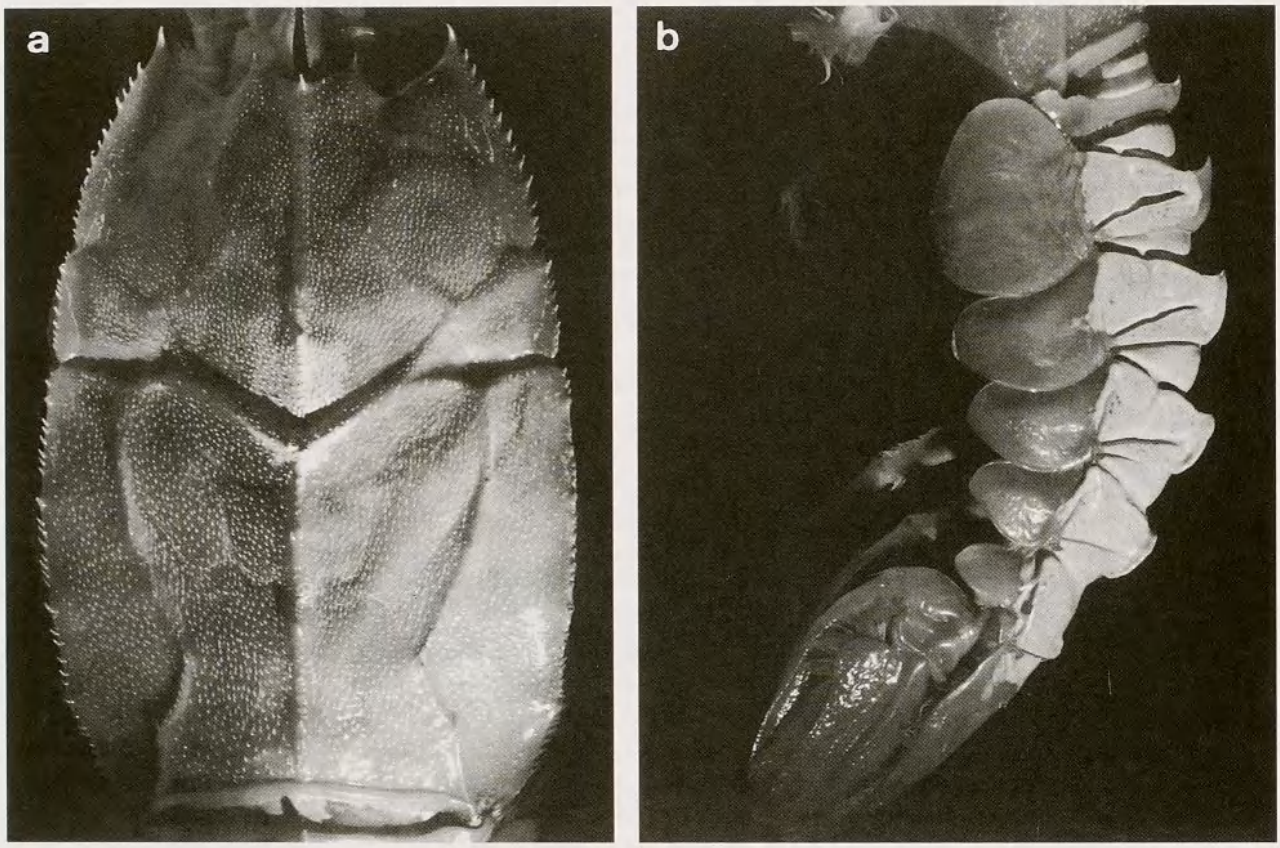

FIG. 31. — *Willemoesia forceps* A. Milne Edwards, 1880, ♀ 71.8 mm *"Pillsbury"* stn 266, 1°12.5'N, 7°46'E, 2507-2562 m (RMNH): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

Willemoesia inornata Faxon, 1893

Fig. 32

Willemoesia leptodactyla Bate, 1878a: 280 (p.p.); 1878c: 563 (p.p.); 1888: 163, pls 18P, 19c" (p.p.). — DE MAN, 1916: 6 (list) [non Willemoes-Suhm, 1875].

Willemoesia inornata Faxon, 1893: 195; 1895: 125, pl. 32 fig. 2, pl. 33 fig. 3. — SEELIGER, 1901: 46. — BOUVIER, 1917: 32 (key). — DE MAN, 1916: 6 (list). — ZARENKOV, 1969: 81. — BAYER *et al.*, 1970: 98. — FIRTH & PEQUEGNAT, 1971: 77. — GORE, 1984: 6. — DAWSON, 1997: 26.

Willemoesia challengeri Sund, 1920: 223. — HOLTHUIS, 1952a: 79. — BAHAMONDE, 1963: 4. — FIRTH & PEQUEGNAT, 1971: 75. — ZARENKOV, 1969: 81. — RETAMAL, 1981: 16. — GORE, 1984: 6. — WICKSTEN, 1989: 304. — DAWSON, 1997: 25.

Willemoesia - WOLFF, 1960: 179; 1961: 148, fig. 17.

MATERIAL EXAMINED. — EASTERN PACIFIC.

Costa-Rica. *"Galathea"*: stn 716, 9°23'N, 89°32'W, 3680 m, 6.05.1952: 3 ♂ 41.6-46.1 mm; 2 ♀ 47.8, 56.1 mm; 1 ov. ♀ 47.5 mm (ZMC).

Gulf of Panama. *"Albatross"*: stn 3382, 6°21'N, 80°41'W, 3227 m, 7.03.1891: 2 ♂ 34.4, 37.9 mm; 3 ♀ 42.7-48.9 mm (USNM 21078).

Source : MNHN, Paris

"Pillsbury": stn 526, 6°53'N, 79°27'W, 3193-3200 m, 5.05.1967: 2 ♂ 39.9, 37.7 mm; 6 ♀ 35.9-49.5 mm (RMNH 23527).

"Gilliss": stn 1, 6°52'N, 79°28'W, 3200-3229 m, 13.01.1972: 2 ♂ 37.5, 39.4 mm; 5 ♀ 43.3-54.6 mm (RMNH). — Stn 3, 6°47'N, 79°13'W, 3045-3158 m, 14.01.1972: 3 ♂ 38.3-44.4 mm; 5 ♀ 41.6-51.0 mm (RMNH). — Stn 4, 6°42'N, 78°56'W, 3173-3208 m, 14.01.1972: 5 ♂ 32.5-40.6 mm; 4 ♀ 40.4-45.5 mm (RMNH). — Stn 6, 6°12'N, 78°33'W, 3475-3517 m, 15.01.1972: 2 ♂ 31.5, 38.6 mm; 2 ♀ 39.8, 51.5 mm (RMNH). — Stn 18, 6°31'N, 78°20'W, 3940-3986 m, 17.01.1972: 1 ♂ 34.9 mm; 5 ♀ 43.5-58.0 mm (RMNH). — Stn 20, 6°45.2'N, 78°31.7'W, 3977-4005 m, 18.01.1972: 2 ♂ 34.0, 38.3 mm; 5 ♀ 40.0-50.6 mm (RMNH).

Ecuador. *"Albatross"*: stn 3399, W Cabo de San Francisco, 1°07'N, 81°04'W, 3132 m, 24.03.1891: 2 ♂ 34.8, 38.6 mm (USNM 21079).

Colombia. *"Galathea"*: stn 724, 5°44'N, 79°20'W, 2712-3330 m, 12.05.1952: 1 ov. ♀ 55.8 mm (ZMC). — Stn 726, 5°49'N, 78°52'W, 3800 m, 13.05.1952: 5 ♂ 39.6-42.9 mm; 4 ♀ 43.3-57.8 mm (ZMC).

Galapagos Is. *"Albatross"*: stn 3400, 0°36'S, 86°46'W, 2380 m, 27.03.1891: 1 ♀ 34.9 mm (USNM 21080).

ARCTURUS EXPEDITION: stn 53, 1°51'S, 89°50'W, 3119 m, 25.04.1925, id. L. BOONE *Willemoesia intermedia*, type (unpublished): 1 ♂ 42.3 mm (AMNH 12402). — Stn 40, 1°51'S, 89°50'W, 2966 m, id. L. BOONE *Willemoesia intermedia*, paratypes (unpublished): 2 ♂ 35.1, 34.5 mm (AMNH 12403).

Chile.*"Challenger"*: stn 298, 34°07'S, 73°56'W, 4005 m, 17.11.1875: 1 ov. ♀ 53.5 mm; 1 ♀ 45.6 mm (NHM 1888.22).

Juan Fernandez Is. *"Challenger"*: stn 300, 33°42'S, 78°18'W, 2475 m, 17.12.1875: 1 ♂ 33.7 mm (NHM 1888.22).

TYPES. — The male (37.9 mm cl) (USNM 21078) collected by the *"Albatross"* stn 3382 off Panama (6°21'N, 80°41'W, 3227 m), is designated here as the lectotype of *Willemoesia inornata* Faxon, 1893; the other specimens in the samples are paralectotypes, as well as the specimens (USNM 21079) collected by the *"Albatross"* stn 3399 off Ecuador and those (USNM 21080) from stn 3400 off Galapagos Is.

The ovigerous female (53.5 mm cl) (NHM 1888.22) collected by the *"Challenger"* stn 298, off Chile (34°07'S, 73°56'W, 4005 m), is designated here as the lectotype of *W. challengeri* Sund, 1920, the female of the sample is a paralectotype, as well as the male (33.7 mm cl) (NHM 1888.22) collected at stn 300 off Juan Fernandez.

DESCRIPTION. — Carapace oblong, margins subparallel, anteriorly convergent; surface densely covered with antrorse spinules. Frontal margin transverse. Rostral spine upcurved. Internal orbital angle bearing small granulate spine, lacking in some larger specimens. Anterolateral angle of carapace formed by large spine. Mesial margin of basal antennular segment prominently spinose, pectinate. Spine formula of lateral margins of carapace 5-8:2-4:0-10, lateral margins of carapace posterior to postcervical incision carinate. Median postrostral carina irregularly spinulate, granulate anteriorly; median postcervical carina unarmed. Gastro-orbital carinae obsolescent, unarmed. Branchial carina prominent, sinuous, unarmed, polished. Posterior margin of carapace unarmed.

First abdominal tergite smooth, bearing tubercle medially on anterior margin. Tergites 2-5 sculptured, bearing deep submedian grooves, medially carinate, carinae culminating in antrorse spine anteriorly, spines increasing in size posteriorly. Sixth tergite with margins, submedian crescents and lyre-shaped median carina swollen. Second pleuron heart-shaped, pleura 3-5 with blunt rib mesially, indented posteriorly. Telson with T-shaped hump anteriorly, smooth convergent carinae posteriorly, unarmed margins, tip rounded. Posterior margin of uropodal endopod rounded.

First chelipeds thin, elongate. Merus swollen proximally; upper margin granulose, subterminally trispinose; lower margin spinose, spines larger proximally. Carpus 4/5 as long as merus, expanded distally; upper margin spinose, distalmost spine largest. Upper margin of chela bearing two files of spines, spines of interior file longer; single file on lower margin of finger.

Color. — Carapace anteriorly pale orange-red, posterior to cervical groove almost colorless, with ridges, spines darker, interior organs purple-red. Abdomen pale to bright reddish-orange; uropods, margin of pleura, ridges and spins darker; legs, pleopods, antennae and antennulae bright reddish-orange (HOLTHUIS pers. obs., specimens collected by the *"Gilliss"* stn 3).

REMARKS. — HOLTHUIS (1952a: 79) found "*Willemoesia inornata* Faxon, (1895) ... closely related to, if not identical with *W. challengeri*." GORE (1984: 6) tentatively placed the *"Galathea"* specimens described by WOLFF (1961), in *W. inornata*. Having examined both the *"Galathea"* and type specimens, I confirm GORE's identification.

Source : MNHN, Paris

W. inornata and *W. leptodactyla* both have the sixth abdominal tergite with margins, submedian crescents and lyre-shaped median carina swollen. *W. inornata* differ from *W. leptodactyla* in having the lateral margins of carapace posterior to postcervical incision bearing less than 10 spines, the upper margin of the first chela with two files of spines, the lower margin with a single file; whereas in *leptodactyla*, the lateral margins of carapace posterior to postcervical incision bear more than 20 spines, the upper margin of the first chela bears several files of spines, the lower margin bearing two files.

DISTRIBUTION. — Eastern Pacific: Gulf of Panama, Colombia, Ecuador, Chile, Juan Fernandez and Galapagos; 2380-4005 m.

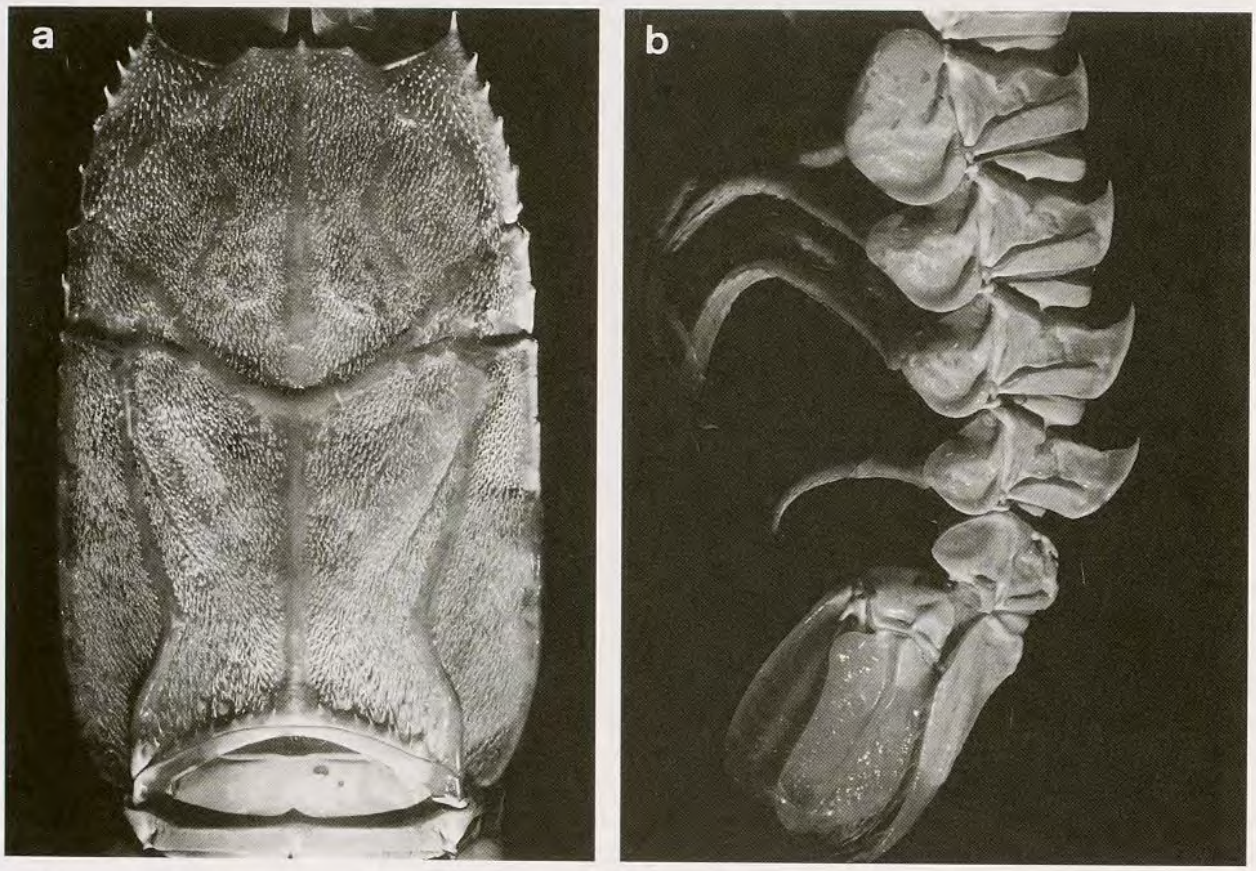

FIG. 32. — *Willemoesia inornata* Faxon, 1893, ♂ 37.9 mm, Eastern Pacific, Panama, *"Albatross"* stn 3382, 6°21'N, 80°41'W, 3227 m (USNM 21078): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

Willemoesia leptodactyla (Willemoes-Suhm, 1875)

Fig. 33

Deidamia leptodactyla Willemoes-Suhm, in THOMSON, 1873: 51, 247, fig. 2. — WOOD-MASON, 1874: 180. — HOLTHUIS, 1956: 114. — HEMMING, 1958: 138. — WOLFF, 1960: 180.

Willemoesia leptodactyla - GROTE, 1873: 485. — HUMBERT, 1874: 130. — WILLEMOES-SUHM, 1875a: 50, pl. 13 figs 1-9; 1875b: 577; 1875c: xxxiii. — THOMSON, 1877: 187, fig. 42. — BATE, 1878a: 280, pl. 13 figs 4-5 (p.p); 1878b: 484 (p.p); 1878c: 563 (p.p); 1888: 163, pls 18-20 (p.p.). — NORMAN, 1879: 175. — PAGENSTECHER, 1879: 37. — CARUS, 1885: 486. — PERRIER, 1886: 293. — W. MARSHALL, 1888: 266. — STEBBING, 1893: 201. — FAXON, 1895: 118. — MURRAY, 1897: 388. — GIGLIOLI, 1912: 158. — DE MAN, 1916: 5 (list). — BOUVIER, 1917: 33, pl. 1 figs 6-15. — SUND, 1920: 221. — STEPHENSEN, 1923: 64. — SIVERTSEN & HOLTHUIS, 1956: 42. — ZARENKOV, 1969: 81. — FIRTH & PEQUEGNAT, 1971: 79. — GORE, 1984, tab. 2. — DAWSON, 1997: 27.

Polycheles leptodactyla - WOOD-MASON, 1875: 132 (p.p.).

Source : MNHN, Paris

Willemoesia forceps - WOOD-MASON & ALCOCK, 1891: 199. — ALCOCK, 1894: 230; 1899: 33; 1902: 155. — BOUVIER, 1905a: 480 (p.p); 1905c: 5 (p.p) [non A. Milne Edwards, 1880].
Willemoesia indica Alcock, 1901b: 178, pl. 1 figs 1-1a. — ALCOCK & MCARDLE, 1903, pl. 57 fig. 5. — BOUVIER, 1917: 32 (key). — DE MAN, 1916: 6 (list). — FIRTH & PEQUEGNAT, 1971: 77. — GORE, 1984: 5. — DAWSON, 1997: 26.
Willemoesia secunda Sund, 1920: 223. — FIRTH & PEQUEGNAT, 1971: 80.
not *Willemoesia leptodactyla* - GIGLIOLI, 1881: 358; 1882: 5 [= *P. sculptus* Smith, 1880].
not *Willemoesia* (*Polycheles*) *leptodactyla* - GIGLIOLI, 1912: 186 [= *P. sculptus* Smith, 1880].
not *Willemoesia leptodactyla* - BAGE, 1938: 9 [= *W. pacifica* Sund, 1920].

MATERIAL EXAMINED. — **ATLANTIC OCEAN. NE Atlantic**. *"Talisman"*. 42°19'N, 23°36'E, 4060 m, 24.08.1883: 1 ♂ 35.0 mm; 2 ♀ damaged (MNHN-Pa 3). — 1 ♀ 52.2 mm (MNHN-Pa 1172).

DORA 2: 46°59.5'N, 14°58.3'W, 4776 m, 29.03.1984: 1 juv. (RMNH).

INCAL 2. 48°20.4'N, 15°14.6'W, 4823 m, 1.08.1976: 1 ♀ 42.0 mm (MNHN-Pa 535).

BBC-96. 49°00.37'N, 13°41.42'W, 4488 m, 29.07.1966: 1 juv. (RMNH).

Canary Is. CANCAP 3: stn 3.105, 29°50'N, 15°46'W, 3400-3550 m, 24.10.1978: 1 ♀ 49.8 mm (RMNH).

CANCAP 4: stn 4.135, 28°27'N, 18°27'W, 4000 m, 1.06.1980: 1 ov. ♀ 71.1 mm (RMNH). — Stn 4.166, 29°48'N, 15°56'W, 3427-3570 m, 6.06.1980: 1 ♀ 37.8 mm (RMNH). — Stn 4.180, 32°48'N, 15°18'W, 3315-3499 m, 9/10.06.1980: 1 ♂ 43.7 mm; 1 ♀ 60.7 mm (RMNH).

Cape verde Is. CANCAP 6: stn 6.002, 14°39'N, 23°21'W, 3650-3840 m, 4-5.05.1982: 1 ♀ 53.8 mm (RMNH). — Stn 6.023, 14°40'N, 24°51'W, 3900-3875 m, 6.06.1982: 3 juvs. (RMNH). — Stn 6.036, 15°04'N, 25°01'W, 4030-4130 m, 8.06.1982: 1 ♂ 49.0 mm; 1 ♀ 41.5 mm (RMNH)

West Africa.*"Gilliss"*: stn 93, 6°30.5'N, 22°06'W, 3446 m, 19.08.1973: 3 juvs. (RMNH 31671). — Stn 94, 5°03.8'N, 20°48.2'W, 2784 m, 20.08.1973: 1 juv. (RMNH). — Stn 99, 0°37.8'N, 18°20.8'W, 4620 m, 22.08.1973: 1 juv. (RMNH 31672).

"Pillsbury": stn 66, 3°31'N, 7°34'W, 4045-4008 m, 2/3.06.1964: 1 ♀ 65.4 mm (RMNH).

WALDA: 18°52.1'S, 7°23.1'E, 5124 m, 06.06.1971: 1 ♂ 54.4 mm; 3 ♀ 49.6-64.4 mm; 2 juvs (MNHN-Pa 653). — 18°28.5'S, 10°31.5'E, 3530 m, 28.06.1971: 1 ♀ 57.9 mm (MNHN-Pa 536). — 17°30'S, 9°27.5'E, 4335 m, 30.06.1971: 1 ♀ 47.4 mm (MNHN-Pa 650). — 12°21.4'S, 11°02.7'E, 3431 m, 11.07.1971: 1 ♂ 40.7 mm; 2 ♀ 52.3, 54.3 mm (MNHN-Pa 652). — 9°26'S, 10°33'E, 4080 m, 15.07.1971: 1 ♂ 45.9 mm (MNHN-Pa 649). — 3°59'N, 3°42.9'E, 3225 m, 14.08.1971: 1 ♀ 51.5 mm; 1 juv. (MNHN-Pa 651).

S. Atlantic. *"Challenger"*: stn 133, 35°41'S, 20°55'W, 3420 m, 11.10.1873: 1 ♀ 38.1 mm (NHM 1888.22).

NW Atlantic. *"Challenger"*: stn 13, 21°38'N, 44°39'W, 3420 m, 4.03.1873: 1 ♀ broken (NHM 1888.22).

Jamaica. *"Pillsbury"*: stn 1180, 18°55'N, 73°53'W, 3109-3493 m, 1.07.1870: 1 ♂ 46.0 mm (RMNH).

Venezuela Basin. *"Bartlett"*: stn 39, 15°08.93'N, 69°13.38'W, 3977-4047 m, 27-28. 10.1981, id. R.H. GORE as *W. indica*: 1 ♂ 51.5 mm; 1 ♀ 58.8 mm (NHM 1984.52); 2 ♂ 35.5, 48.4 mm; 2 ♀ 37.5, 38.5 mm; 4 juvs (NHM 1984.55). — Stn 65, 13°51.8'N, 67°52.4'W, 5000 m, 10.11.1981, id. R.H. GORE as *W. indica:* 1 ♂ 68.2 mm; 1 ♀ 69.3 mm (LAM ex AHF 2491-02); 1 ♂ 38.0 mm (LAM ex AHF 2491-03). — Stn 87, W Aves ridge, 13°36.36'N, 64°6.12'W, 3640 m, 25.11.1981: 1 ♂ 33.8 mm; 1 ♀ 66.5 mm; 2 juvs (USNM 210821); 1 ov. ♀ 82.2 mm (USNM 210822); 3 ♀ 55.6-78.5 mm; 2 juvs (USNM 210823).

INDIAN OCEAN. Tasman Sea.*"Galathea"*: stn 607, 44°18'S, 166°46'E, 3930 m, 7.01.1952: 1 ♀ 35.6 mm (ZMC).

Java Deep. *"Galathea"*: stn 474, 9°49'S, 114°13'E, 3920 m, 11.09.1951: 1 ♀ 58.2 mm (ZMC).

Bay of Bengal. *"Investigator"*: stn 117, 11°58'N, 88°52'17"E, 3197 m, 13.12.1890: 1 ♂ 53 mm (IM 6871/9).

"Galathea": stn 299, 17°10'N, 84°34'E, 2935 m, 24.04.1951: 7 ♂ 37.2-51.9 mm; 1 ♀ 80.9 mm; 1 ov. ♀ 80.1 mm (ZMC). — Stn 314, 15°54'N, 90°17'E, 2610 m, 3.05.1951: 5 ♂ 35.3-42.0 mm; 7 ♀ 37.2-45.3 mm (ZMC).

Mid Indian Basin. SAFARI 2: stn 2-CP 03, 5°48'N, 78°43'E, 3450 m, July-Sept. 1981: 1 ♀ 58.7 mm (MNHN). — Stn 35-CP 28, 12°52.9'S, 79°32.1'E, 4950 m, July-Sept. 1981: 1 ♀ (MNHN-Pa 1751).

Madagascar.*"Galathea"*: stn 235, 4°47'S, 46°19'E, 4940 m, 11.03.1951: 1 juv. (ZMC).

South Africa. *"Galathea"*: stn 192, 32°00'S, 32°41'E, 3615 m, 5.02.1951: 3 ♂ 25.4-50.1 mm (ZMC).

TYPES. — The female (broken) (NHM 1888.22) collected by the *"Challenger"* stn 13 in the NW Atlantic (21°38'N, 44°39'W, 3420 m), is the holotype of *Willemoesia leptodactyla* (Willemoes-Suhm, 1875).

The male (53 mm cl) (IM 6871/9) collected by the *"Investigator"* stn 117 in the Bay of Bengal (11°58'N, 88°52'17"E, 3197 m), is the holotype of *Willemoesia indica* Alcock, 1901.

The female (38.1 mm cl) (NHM 1888.22) collected by the *"Challenger"* stn 133 in the South Atlantic (35°41'S, 20°55'W, 3420 m), is the holotype of *Willemoesia secunda* Sund, 1920.

DESCRIPTION. — Carapace oblong, lateral margins subparallel, anteriorly convergent. Dorsal surface of carapace densely covered with antrorse spinules. Rostral spine upcurved. Frontal margin of carapace transverse. Internal angle of orbital sinus spinose. Eyestalk bulbous, bearing short curved spine. Mesial margin of basal

Source : MNHN, Paris

antennular segment spinose, pectinate. Lateral margins of carapace spinose, spines increasing in size anteriorly, anteriormost largest; spine formula 8-10:5-7:15-25. Median postrostral carina prominent, granulate; spine formula variable; spines on median postcervical carina larger posteriorly. Gastro-orbital carina sinuous, sparsely spinulose. Branchial carina sinuous, prominent, spinose. Posterior margin of carapace smooth.

First abdominal tergite smooth, bearing tubercle medially on anterior margin. Tergites 2-5 sculptured, with deep submedian grooves, medially carinate, carinae culminating in antrorse spine anteriorly, spines increasing in size posteriorly. Sixth tergite with swollen margins, submedian crescents and lyre-shaped median carina; median carina more prominent posteriorly. Second pleuron heart-shaped; pleura 3-5 with blunt rib mesially, indented posteriorly. Telson with T-shaped hump anteriorly, smooth convergent carinae posteriorly, unarmed margins, tip rounded. Posterior margin of uropodal endopod rounded.

First chelipeds thin, elongate. Merus swollen proximally; upper margin granulose, distally bispinose, distalmost spine larger; lower margin spinose, spines larger proximally. Carpus 3/4 as long as merus expanded distally; upper margin spinose, distalmost spine largest. Upper margin of chela bearing several irregular files of spines; lower margin bearing two files, spines of interior file longer; single file along lower margin of finger.

Color. — "very beautiful... it was of a fine red, while the hairs bordering it were yellowish" (WILLEMOES-SUHM, 1875a: 53). "..brick orange to light pinkish orange overall... juveniles white, or translucent pink with reddish highlights on cephalothorax. Sensory appendages and pereopods usually a solid salmon red or pink in larger individuals, translucent white in smaller specimens." (GORE, 1984: 7).

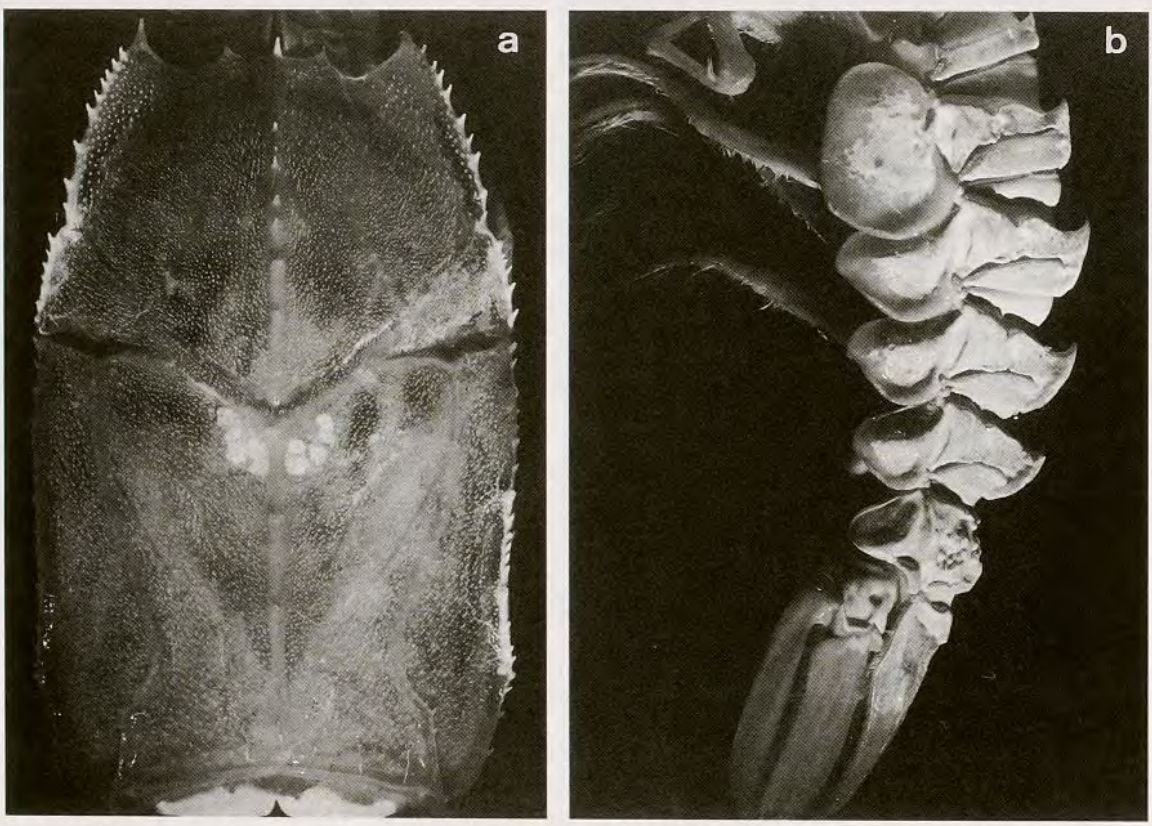

FIG. 33. — *Willemoesia leptodactyla* (Willemoes-Suhm, 1875), ♀ 66.5 mm, Venezuela Basin, *"Bartlett"* stn 87, 13°36.36'N, 64°46.12'W, 3640 m (USNM 210821): **a**, cephalothorax, dorsal view; **b**, abdomen, lateral view.

REMARKS. — "*W. leptodactyla* does not have the embossment, as is clearly seen from WILLEMOES-SUHM's (1875) illustration" (GORE, 1984: 8) - an omission of the characteristic lyre-shaped median carina and submedian crescents from the early illustrations of *W. leptodactyla*, coupled with BATE's (1878a: 280) erroneous count of the lateral spines, contributed to the creation of several synonymies.

Source : MNHN, Paris

DISTRIBUTION. — Worldwide: east Atlantic and west Atlantic (Jamaica to Venezuela), Indo-West Pacific (Tasman Sea, Philippines, Bay of Bengal, Madagascar, South Africa); 2396 m (ALCOCK, 1906) - 5124 m (present work).

Willemoesia pacifica Sund, 1920

Figs. 34

Willemoesia leptodactyla Bate, 1878a: 280 (p.p); 1878c: 563 (p.p.); 1888: 163, pl.19 fig. c (p.p). — DE MAN, 1916: 6. — BAGE, 1938: 9 [non Willemoes-Suhm, 1875].
Willemoesia pacifica Sund, 1920: 223. — HOLTHUIS, 1952a: 79. — BAHAMONDE, 1963: 4. — ZARENKOV, 1969: 81. — FIRTH & PEQUEGNAT, 1971: 80. — RETAMAL, 1981: 16. — WICKSTEN, 1989: 304.
Willemoesia forceps - BERNARD, 1953: 88, fig. 36 [non A. Milne Edwards, 1880].
Willemoesia bonaspei Kensley, 1968: 294, figs 4-5; 1974: 69; 1981b: 29. — GORE, 1984, tab. 2. — GRIFFIN & STODDART, 1995: 251, figs 16-17. — DAWSON, 1997: 25.

MATERIAL EXAMINED. — **South Africa**. Cape Point, 34°36'S, 17°00'E, 2745 m, 10.12.1959: 1 ov. ♀ 48.4 mm (SAM A10543).
Juan Fernandez Is. *"Challenger"*: stn 300, 33°42'S, 78°18'W, 2475 m, 17.12.1875: 1 ♂ 46.3 mm (NHM 1888.22).
Kermadec Trench. *"Dana"*: stn 3627, 30°08'S, 176°50'W, 5000 m, 14.12.1928: 1 juv. (ZMC 3274).
New Zealand. NZOI: stn U195, 34°31.5'S, 166°21.0'E, 2930-2928 m, 23.09.1982: 1 ♂ 32.5 mm (NIWA). — Stn V196, 33°03'S, 165°22.4'E, 3118-3120 m, 24.09.1982: 1 ♂ 38.4 mm (NIWA).

TYPE. — The male (46.3 mm cl) (NHM 1888.22) collected by the *"Challenger"* stn 300, off Juan Fernandez Is (33°42'S, 78°18'W, 2475 m), is the holotype of *Willemoesia pacifica* Sund, 1920.
The female (48.4 mm cl) (SAM A10543) collected off Cape Point, South Africa, is the holotype of *Willemoesia bonaspei* Kensley, 1968.

DESCRIPTION. — Carapace oblong, lateral margins subparallel, convergent anteriorly. Dorsal surface of carapace close-set with antrorse spinules. Rostral spine long, upcurved. Frontal margin of carapace trigonally excavate, internal angle of orbital sinus prominently spinose. Eyestalk bulbous, bearing curved spine. Mesial margin of basal antennular segment prominently spinose. Lateral margins of carapace spinose, spines increasing in size anteriorly, spine formula 6-10:5-8:18-30. Median postrostral carina well defined, spine formula variable; postcervical median carina irregularly spinose, spines larger posteriorly. Gastro-orbital carina obsolescent, sinuous, spinose. Branchial carina sinuous, prominent, spinose. Posterior margin of carapace smooth.
Abdominal tergites lacking obliquely transverse grooves, medially carinate; carinae 1-3 anteriorly dentate, denticle increasing in size posteriorly. Tergites 4-5 carinate, lacking antrorse denticle. Sixth tergite smooth. Abdominal pleura smooth, margins unarmed; second pleuron subcircular. Telson with triangular hump anteriorly, polished submedian carinae posteriorly, margins spinulate, tip acuminate. Margin of uropodal endopod triangulate.
First cheliped long, thin. Upper margin of merus granulate, distally with claw-like spine; lower margin spinose, spines longer proximally. Carpus 3/4 as long as merus; upper margin spinose, subterminal claw-like spines on upper and lower margins. Upper margin of chela with two spinose rows, spines on interior row longer; lower margin with single row of spinules, continuing to finger.

REMARKS. — BATE (1888: 169) described one of the Juan Fernandez specimens as having "the telson longer and more pointed and the outer foliaceous plates of the rhipidura somewhat pointed at the extremity" but thought it "a decided variety of *Willemoesia leptodactyla*". KENSLEY (1968: 297) found *W. bonaspei* "closely related to several described species, such as *leptodactyla* (Willemoes-Suhm), *pacifica* Sund, or *challengeri* Sund", but mostly it "resembles Bate's 1888 plate 19 C (a specimen captured off the coast of Chile and named *pacificus* by Sund in 1920)". GRIFFIN & STODDART (1995: 251) thought *W. bonaspei* "is very close to *W. pacificus* and, as suggested by Kensley, may be found to be synonymous with it when more material becomes available". Examination of both types proved them right.
W. pacifica differs from its congeners in lacking the deep submedian grooves on its abdominal tergites, in its entirely smooth sixth abdominal tergite, and its acuminate telson.

Source : MNHN, Paris

DISTRIBUTION. — The southern ocean: South Africa, Juan Fernandez Is, Kermadec Trench, New Zealand; 2475-5000 m.

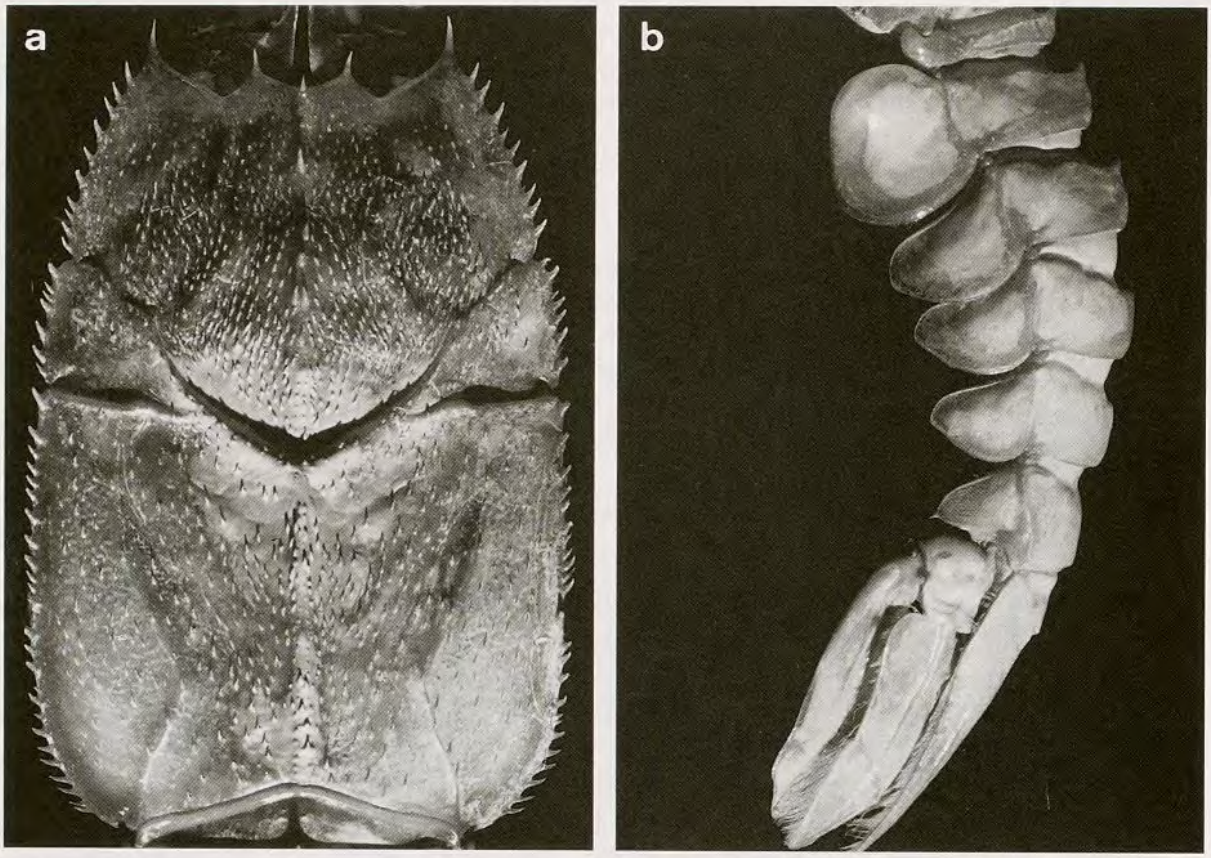

FIG. 34. — *Willemoesia pacifica* Sund, 1920, ♂ 46.3 mm, holotype, Juan Fernandez I., *"Challenger"* stn 300, 33°42'S, 78°18W, 2475 m (NHM 1888.22): **a**, dorsal view of the cephalothorax; **b**, lateral view of the abdomen.

CONCLUSIONS

The polychelids are prominent members of the deep sea biota, yet, choosing the bathyal as their abode, they are considered rare. Though there are a few reports of abundant hauls, like that of the *"Pillsbury"* off West Africa, where surplus specimens were shoveled overboard (HOLTHUIS, 1991), most are known from a small number of specimens scattered among distant museums. The polychelid collections assembled through the MUSORSTOM deep-sea cruises allowed for examination of large series of specimens and analysis of the validity of characters used to separate species and genera. The resulting taxonomic revision replaced the long established "three living genera in the *Polychelidae*: *Polycheles* Heller, 1862; *Stereomastis* Bate, 1888; and *Willemoesia* Grote 1873" (FIRTH & PEQUEGNAT, 1971:5), with five genera of which only *Willemoesia* retains its primary meaning. The study of extensive collections and most type specimens revealed many synonymies, and helped reduce the number of polychelid species known from single specimens from twelve (FIRTH & PEQUEGNAT, 1971: 32) to one - *Homeryon asper* (Rathbun, 1906). This taxonomic rearrangement resulted in reshuffling of geographic and bathymetric ranges. Accordingly, five polychelid species are now known to occur only in the Atlantic, nineteen occur solely in the Indo-Pacific, whereas eight are found in both oceans - contrary to the notion "Most polychelid species appear to be endemic to particular ocean basins" (FIRTH & PEQUEGNAT, 1971: 16). Of the five species listed by FIRTH & PEQUEGNAT (1971: 16) as endemic to the Atlantic, one, *validus*, occurs from the eastern

Source : MNHN, Paris

Pacific to the Indian Ocean, another, *leptodactyla*, from the Tasman Sea to South Africa, and a third, *secunda*, is but a junior synonym of the latter. Two taxa, *Polycheles perarmata* and *Willemoesia forceps*, occur on both sides of tropical Atlantic, whereas *Willemoesia inornata* was found on both sides of the isthmus of Panama. *Willemoesia pacifica* and *Polycheles suhmi* inhabit the southern oceans, both Atlantic and Indo-Pacific. Some species such as the above mentioned *Homeryon asper*, *Pentacheles gibba*, *Polycheles cerata* and *Polycheles trispinosus*, all described nearly a century ago, are presumably rare and of limited range.

TABLE 1. — Geographical distribution of the Polychelidae.

	1	2	3	4	5	6	7	8	9	10	11	12	13
Cardus crucifer		+		+	+								
Homeryon armarium								+					
Homeryon asper									+				
Pentacheles gibbus												+	
Pentacheles laevis		+	+		+		+		+	+	+	+	
Pentacheles obscurus									+	+	+	+	+
Pentacheles snyderi		+							+			+	
Pentacheles validus		+	+	+	+	+	+		+	+		+	
Polycheles aculeatus										+	+		
Polycheles auriculatus									+	+	+		
Polycheles baccatus									+	+	+		
Polycheles ceratus										·	+	+	
Polycheles coccifer										+	+		
Polycheles enthrix									+	+	+		
Polycheles evexus							+						
Polycheles helleri								+		+	+	+	
Polycheles nanus		+	+	+	+			+	+	+	+	+	+
Polycheles pacificus							+						
Polycheles perarmatus			+			+							
Polycheles phosphorus								+	+	+	+	+	
Polycheles politus											+		
Polycheles sculptus	+	+	+	+	+	+	+	+		+	+	+	+
Polycheles suhmi				+			+			+			
Polycheles surdus							+		+	+		+	+
Polycheles talismani			+	+									
Polycheles tanneri							+						
Polycheles trispinosus											+		
Polycheles typhlops	+	+	+		+	+				+	+	+	+
Willemoesia forceps			+			+							
Willemoesia inornata						+	+						
Willemoesia leptodactyla		+	+			+				+	+	+	+
Willemoesia pacifica				+			+		+	+			

1. Mediterranean Sea; **2**. Northeast Atlantic; **3**. West Africa; **4**. South Africa; **5**. Northwest Atlantic; **6**. Tropical West Atlantic; **7**. East Pacific; **8**. Northeast Pacific; **9**. Central Pacific; **10**. Southwest Pacific (New Guinea, Australia, New Caledonia, New Zealand); **11**. Southeast Asia (South China Sea, Philippines, Indonesia); **12**. Indian Ocean; **13**. East Africa

Source : MNHN, Paris

All but four polychelid species occur only beyond the continental shelf, most are found in the mid-bathyal depths of 500-1500 m. However, the four species of *Willemoesia* inhabit the abyssal, occurring exclusively at depths greater than 2000 m - a specimen of *leptodactyla* even hauled from 5060 m.

On the 125th anniversary of the first deep-sea cruise, we note that the challenge of the *"Challenger"* has not been met - there is still much to discover on the bottom of the sea.

TABLE 2. — Vertical distribution of the Polychelidae

Depth (m)	0-200	-500	-1000	-2000	-3000	-4000	-5000
Cardus crucifer			+	+	+		
Homeryon armarium			+				
Homeryon asper				+			
Pentacheles gibbus				+			
Pentacheles laevis		+	+	+	+		
Pentacheles obscurus				+	+	+	
Pentacheles snyderi			+	+	+		
Pentacheles validus			+	+	+	+	
Polycheles aculeatus	+	+	+	+			
Polycheles auriculatus			+	+			
Polycheles baccatus		+	+	+			
Polycheles ceratus				+			
Polycheles coccifer	+	+	+				
Polycheles enthrix		+	+	+			
Polycheles evexus				+	+		
Polycheles helleri			+	+	+		
Polycheles nanus		+	+	+	+	+	
Polycheles pacificus			+	+	+	+	
Polycheles perarmatus	+	+	+				
Polycheles phosphorus		+	+	+			
Polycheles politus		+	+	+			
Polycheles sculptus		+	+	+	+	+	
Polycheles suhmi		+	+	+	+		
Polycheles surdus		+	+	+			
Polycheles talismani	+	+	+	+	+		
Polycheles tanneri			+				
Polycheles trispinosus			+				
Polycheles typhlops	+	+	+	+	+		
Willemoesia forceps					+	+	+
Willemoesia inornata					+	+	+
Willemoesia leptodactyla					+	+	+
Willemoesia pacifica					+	+	+

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Source : MNHN, Paris

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7

Crustacea Decapoda: *Porcellanopagurus* Filhol and *Solitariopagurus* Türkay (Paguridae), from the New Caledonian area, Vanuatu and the Marquesas: new records, new species

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ABSTRACT

The very interesting and rather specialized hermit crab genera *Porcellanopagurus* and *Solitariopagurus* are represented in collections from the MUSORSTOM cruises to New Caledonia and the Marquesas by four species of the former and three of the latter. Among the species of *Porcellanopagurus*, three species, *P. tridentatus* Whitelegge, *P. filholi* de Saint Laurent & McLaughlin, and *P. chiltoni* de Saint Laurent & McLaughlin have heretofore been reported only from Australia and New Zealand; *P. haptodactylus* sp. nov. is a distinctive species, new to science. *Solitariopagurus triprobolus* Poupin & McLaughlin is reported for the first time beyond the islands of French Polynesia, and the range of *S. tuerkayi* McLaughlin is extended from the Kai and Tanimbar Island of Indonesia to New Caledonia, Vanuatu and Okinawa. A new species, *S. trullirostris* sp. nov., is described from New Caledonia and the Marquesas. The similarities and differences of the two genera are elucidated, and an apparently rare attribute, a terminal anus, common to some species of both is discussed.

The new species are fully described and illustrated, while diagnoses and illustrations of principal diagnostic characters are provided for the previously described species. Keys to the Indo- and western Pacific species of *Porcellanopagurus* and to the genus *Solitariopagurus* are included.

RÉSUMÉ

Crustacea Decapoda : *Porcellanopagurus* Filhol et *Solitariopagurus* Türkay (Paguridae) de la région néo-calédonienne, de Vanuatu, et des îles Marquises : nouvelles observations et nouvelles espèces.

Les genres très intéressants et plutôt spécialisés de bernard-l'ermite *Porcellanopagurus* et *Solitariopagurus* sont représentés, dans les collections rassemblées lors des campagnes MUSORSTOM en Nouvelle-Calédonie et aux îles Marquises, par quatre espèces appartenant au premier genre et trois au second. Parmi les espèces de *Porcellanopagurus*,

MCLAUGHLIN, P.A., 2000. — Crustacea Decapoda: *Porcellanopagurus* Filhol and *Solitariopagurus* Türkay (Paguridae), from the New Caledonian area, Vanuatu and the Marquesas: new records, new species. *In*: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 21. *Mémoires du Muséum national d'Histoire naturelle*, **184**: 389-414. Paris ISBN-2-85653-526-7.

Source : MNHN, Paris

trois espèces, *P. tridentatus* Whitelegge, *P. filholi* de Saint Laurent & McLaughlin, et *P. chiltoni* de Saint Laurent & McLaughlin n'avaient été récoltées, jusqu'à présent, qu'en Australie et en Nouvelle-Zélande. La quatrième espèce, *P. haptodactylus* sp. nov., est une espèce distincte, nouvelle pour la Science. *Solitariopagurus triprobolus* Poupin & McLaughlin est signalé pour la première fois en dehors de la Polynésie française, et la répartition de *S. tuerkayi* McLaughlin est étendue des îles Kai et Tanimbar, en Indonésie, à la Nouvelle-Calédonie, au Vanuatu et à Okinawa. Une espèce nouvelle, *S. trullirostris* sp. nov., est décrite de la Nouvelle-Calédonie et des îles Marquises. Les similarités et différences des deux genres sont mises en lumière et un caractère apparemment rare, un anus terminal, commun à quelques espèces des deux genres, est discuté.

Les espèces nouvelles sont décrites et illustrées en détail, tandis que des diagnoses et des illustrations des principaux caractères diagnostiques des espèces déjà décrites sont publiées. Des clés d'identification pour les espèces indo-ouest pacifiques de *Porcellanopagurus* et pour les espèces du genre *Solitariopagurus* sont proposées.

INTRODUCTION

The genera *Porcellanopagurus* Filhol, 1885a, and *Solitariopagurus* Türkay, 1986, have been distinguished from other pagurid genera principally by their broad, vaulted carapaces, each provided with prominent lateral carapace projections. In contrast to most other pagurid genera, it is the cephalothorax that provides the most reliable diagnostic characters, e.g., size, shape and development of the rostrums, lateral projections and lateral carapace lobes. Phylogenetically, *Porcellanopagurus* and *Solitariopagurus* have been considered classic examples of carcinization in the Anomura (e.g., BORRADAILE, 1916b; WOLFF, 1961; TÜRKAY, 1986), although the carcinization hypothesis has recently been disputed by MCLAUGHLIN & LEMAITRE (1997, in press). *Porcellanopagurus* also has aroused behavioral and ecological interest because females have been reported as carrying their eggs dorsally, and species of this genus utilize limpet or halves of bivalve shells as protective coverings. *Solitariopagurus* is a more recently recognized genus, with fewer representatives; however, females similarly appear to carry their eggs dorsally, and for at least two species the protective covering of choice is a bivalve shell.

A seemingly rare morphological attribute shared by species of *Porcellanopagurus* and *Solitariopagurus*, but overlooked until now, sets these genera apart, not only from most other hermit crabs, but from the vast majority of decapods as well. In their description of *Porcellanopagurus adelocercus* McLaughlin & Hogarth, 1998, these authors commented that the telson was separated from the tergite of the sixth abdominal somite by membranous tissue, and that the amount of separation increased with increased animal size. Additionally, although they did not comment, they illustrated (MCLAUGHLIN & HOGARTH, 1998, fig. 29) the very unusual condition of a terminal anus. In the new species of both *Porcellanopagurus* and *Solitariopagurus* described herein, the anal opening is also terminal. In these two taxa, the telson similarly would seem to be separated by some distance from the posterior margin of the tergite of the sixth abdominal somite, and carried ventrally under the abdomen. Thus it might appear that the terminal position of the anus could be a function of this correspondingly distinctive telsonal development. However, in the course of examining the three other species of *Porcellanopagurus* occurring in New Caledonia and the Marquesas, as well as both *Solitariopagurus tuerkayi* McLaughlin, 1997, and *S. triprobolus* Poupin & McLaughlin, 1996, the terminal, or nearly terminal, anal position appears to be characteristic of both genera and not simply correlated with the positioning of the telson.

Although the two genera are, in other morphological aspects, superficially also very similar, several aspects of their morphology immediately demarcate them. The most obvious are the lateral carapace projections. In *Porcellanopagurus* (Fig. 1a) two pairs of lobes develop from the lateral margins of the shield, anterior to the cervical groove; a pair of prominent posterior carapace lobes develop directly behind the cervical groove, connected usually by a narrow median element. In contrast, three pairs of lobes develop anterior to the cervical groove in *Solitariopagurus* (Fig. 1b) while the posterior lobes are represented by a moderately broad median and two small lateral elements. MCLAUGHLIN (1997) referred to the *linea transversalis* of *S. tuerkayi* as being represented by a well calcified transverse rod. In reality, the *linea transversalis*, a chitinous hinge (cf. PILGRIM, 1973) separating the posterior margin of the shield from the median portion of the posterior carapace, is rarely visible externally in *Solitariopagurus* species. MCLAUGHLIN's (1997) *linea transversalis* is actually the median element of the posterior carapace lobes of that species.

Source : MNHN, Paris

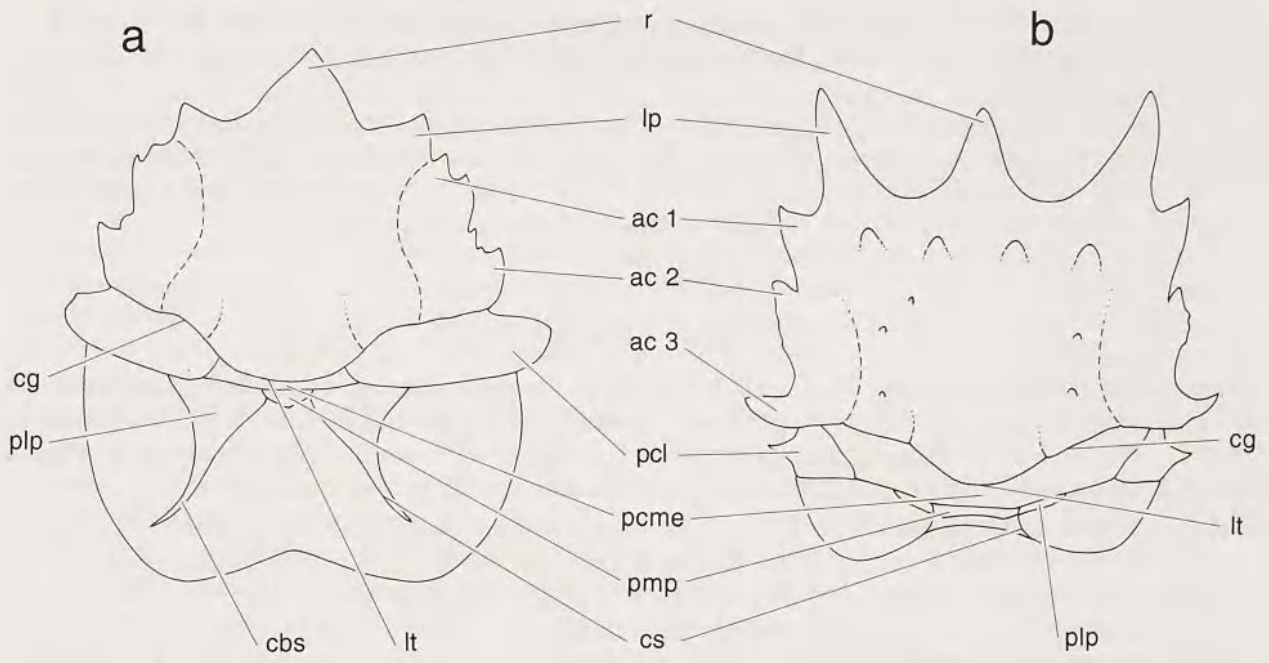

FIG. 1. — Diagrammatic cephalothorax: **a**, *Porcellanopagurus edwardsi* Filhol, 1885; **b**, *Solitariopagurus triprobolus* Poupin & McLaughlin, 1996.

ac 1: anterior carapace lobe 1; **ac 2**: anterior carapace lobe 2; **ac 3**: anterior carapace lobe 3; **cs**: *cardiac sulcus*; **cbs**: *sulcus cardiobranchialis*; **cg**: cervical groove; **lp**: lateral projection; **lt**: location of *linea transversalis*; **pcl**: posterior carapace lateral lobe or element; **pcme**: posterior carapace median element; **plp**: posterolateral plate; **pmp**: posteromedian plate; **r**: rostrum.

A less obvious, but equally significant difference is the gill number. Eleven pairs of biserial phyllobranchiate gills are present in species of *Porcellanopagurus* but only ten pairs in *Solitariopagurus* species. Pleopods are entirely absent in males of both genera; however, different levels of secondary sexual modification occur. In some *Porcellanopagurus* species, one or both coxae of the fifth pereopods may be somewhat drawn out or elongated, and rarely a very slight extrusion of the vas deferens produces a short right sexual tube (cf. MCLAUGHLIN & HOGARTH, 1998). In contrast, species of *Solitariopagurus* all have very well developed male sexual tubes. These tubes appear also to be true coxal extensions but with development comparable to that seen in certain species of the coenobitid genus *Coenobita* Latreille, 1829. At least in *S. triprobolus*, the tubes exhibit a slight amount of calcification, whereas in *S. trullirostris* sp. nov. they are membranous. Females of both genera have only three unpaired pleopods, pseudo-dorsally positioned (cf. MCLAUGHLIN & HOGARTH, 1998). However, females of *Porcellanopagurus* have paired gonopores, while females of *Solitariopagurus* have a single left gonopore. Although the use of halves of bivalves shells as carcinoecia, is common to species of both genera, the structure of the fourth pereopods in *Porcellanopagurus* species is usually semichelate, and that of the fifth, chelate. In contrast both the fourth and fifth pereopods of species of *Solitariopagurus* are subchelate.

Currently 12 species are assigned to *Porcellanopagurus*. These include four from the north and central western Pacific: *P. japonicus* Balss, 1913 and *P. truncatifrons* Takeda, 1981, from Japan, *P. nihonkaiensis* Takeda, 1985, from the Ogasawara Islands, and *P. belauensis* Suzuki & Takeda, 1987, from the Palau Islands. The description of one additional new species from Guam is in preparation (KROPP & ELDREDGE, personal communication). Two species have been described from the eastern Pacific: *P. platei* Lenz, 1902, from Juan Fernandez Island (incorrectly reported as Eastern Island by de SAINT LAURENT and MCLAUGHLIN, 2000), and *P. foresti* Zarenkov, 1990 from the Sala-y-Gómez Ridge. Four species have been reported from Australian-New Zealand waters: *P. edwardsi* Filhol, 1885, *P. tridentatus* Whitelegge, 1900, *Porcellanopagurus filholi* de Saint Laurent & McLaughlin, 2000, and *Porcellanopagurus chiltoni* de Saint Laurent & McLaughlin, 2000. *Porcellanopagurus jacquesi* McLaughlin, 1997, was recently described from the Kai Islands of Indonesia, and in the Indian Ocean, *P. adelocercus*, a dwarf species,

Source : MNHN, Paris

was described from the Seychelles. One species, *P. haptodactylus* sp. nov., is described herein, and range extensions are reported for *P. tridentatus*, *P. chiltoni* and *P. filholi*. A key to the Indo- and Western-Pacific species of the genus is provided.

To date, only three species have been assigned to *Solitariopagurus*. The type species, *S. profundus* Türkay, 1986, was described from the Red Sea. More recently *S. triprobolus* was described from French Polynesia and *S. tuerkayi* from the Kai and Tanimbar Islands of Indonesia. Range extensions are reported for *S. triprobolus* and *S. tuerkayi*, one new species is described, and a key to species of the genus is provided.

MATERIALS AND METHODS

Information on the cruises where the samples studied herein were collected can be found in RICHER DE FORGES, 1990 for BIOCAL, CHALCAL 2, MUSORSTOM 4, 5 and 6, SMIB 2; LEHODEY *et al.*, 1992 for BERYX 11; RICHER DE FORGES, 1993 for VOLSMAR and SMIB 5; BOUCHET, 1994 for the MONTROUZIER EXPEDITION; RICHER DE FORGES & CHEVILLON, 1996 for BATHUS 1; RICHER DE FORGES *et al.*, 1999 for MUSORSTOM 9.

The specimens are deposited in the Muséum national d'Histoire naturelle, Paris (MNHN). Comparative materials of the Australian, New Zealand, and South African species of *Porcellanopagurus* have come from the collections of the Australian Museum, Sydney (AM), the New Zealand Oceanographic Institute, now part of the National Institute of Water and Atmospheric Research, Wellington (NZOI), the Museum of New Zealand Te Papa Tongarewa (formerly the National Museum of New Zealand), Wellington (NMNZ), and the South African Museum, Cape Town (SAM). One additional specimen of *Solitariopagurus tuerkayi* from Okinawa is deposited in the collections of the National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM).

In the lists of material examined the capital letters preceding the station numbers refer to the gear used: **CC** otter trawl (shrimps), **CP** beam trawl, **DR** rock dredge, **DC** Charcot dredge; **DW** Warén dredge, while the abbreviation **ov.** indicates ovigerous female.

General terminology follows that of MCLAUGHLIN (1974); the terms semi- and subchelate are used according to the definition of MCLAUGHLIN (1997), and gill type as defined by MCLAUGHLIN & DE SAINT LAURENT (1998). Terminology for the carapace grooves, linea, and sulci follows that given by PILGRIM (1973) and MORGAN & FOREST (1991). One measurement, shield length, indicative of animal size, is given in parentheses following the number and sex of the specimens.

SYSTEMATIC ACCOUNT

PORCELLANOPAGURUS Filhol, 1885

Porcellanopagurus Filhol, 1885a: 47; 1885b: 23; 1885c: 410. — BORRADAILE, 1916b: 111. — BENNETT, 1932: 520. — FOREST, 1951a: 82; 1951b: 182. — WOLFF, 1961: 28. — MIYAKE, 1978: 117. — TÜRKAY, 1986: 140. — MCLAUGHLIN, 1997: 464. — DE SAINT LAURENT & MCLAUGHLIN, 2000: 105.

TYPE SPECIES. — *Porcellanopagurus edwardsi* Filhol, 1885, by monotypy. Genus masculine.

DIAGNOSIS. — Eleven pairs of biserial phyllobranchiate gills. Anterior carapace vaulted and well calcified; lateral margins of shield developed into two pairs of blunt or spinose lobes. Rostrum and lateral projections widely separated. Anterolateral plates of posterior carapace calcified anteriorly and usually drawn out into projecting lobes; remainder of carapace membranous or with areas of some calcification. Ocular acicles reduced, simple; obscured from dorsal view. Maxillule with external lobe of endopod slightly produced, not recurved. Third maxilliped with well developed crista dentata and 1 accessory tooth.

Chelipeds unequal; propodal-carpal articulation of right with considerable clockwise rotation. Ambulatory legs generally similar. Fourth pereopods usually semichelate; with single row of scales in propodal rasp. Fifth pereopods chelate.

Source : MNHN, Paris

Males usually without extrusion of vas deferens forming membranous sexual tube on coxa of one or both fifth pereopods, but often with coxae slightly drawn out ventromesially; without paired or unpaired pleopods. Females with paired gonopores; no paired pleopods, unpaired left pleopods on somites 2 to 4. Abdomen usually globular, membranous, but with tergites at least faintly delineated. Uropods symmetrical or slightly asymmetrical. Telson partially calcified or entirely membranous, telsonal tergite contiguous or not with tergite of sixth abdominal somite; anus terminal or nearly so.

REMARKS. — MCLAUGHLIN (1997) and MCLAUGHLIN & HOGARTH (1998) referred inaccurately to the weakly calcified anterolateral plates of the posterior carapace as the "*cardiac sulci*". As clearly indicated by MORGAN & FOREST (1991), the *cardiac sulci* laterally delineate the posterior median plate, which in *Tisea grandis* Morgan & Forest, 1991 is represented by a calcified median triangular region. In *Porcellanopagurus* species, a pair of triangular lateral plates are frequently weakly calcified (Fig. 1a). These appear to represent the posterolateral plates of PILGRIM (1973) that are bounded laterally by the *sulci cardiobranchialis*, and mesially, by the *cardiac sulci*, which also delineate the lateral boundaries of the weakly calcified posteromedian plate.

Reference to the telson was intentionally omitted in the generic diagnosis of *Porcellanopagurus* given by MCLAUGHLIN (1997). As pointed out by MCLAUGHLIN & HOGARTH (1998), although in most species of the genus, a typical pagurid-like telson is developed, in two Japanese species, *P. truncatifrons* and *P. nihonkaiensis*, the telson was described or implied as being absent. Of *P. truncatifrons*, TAKEDA (1981: 12) commented "It is remarkable that I failed to find the telson, but the presence of marginal hairs along the posterior border of the penultimate segment may justify the absence of the telson." TAKEDA (1985) illustrated only the sixth abdominal somite and uropods, but made no comment about the missing telson in *P. nihonkaiensis*. MCLAUGHLIN & HOGARTH (1998), in their description of *P. adelocercus*, noted the fact that while the telson would also appear to be lacking if a specimen was viewed only dorsally, a membranous telson, apparently not contiguous with the sixth abdominal somite could be detected ventrally. A similar condition occurs in *P. haptodactylus* sp. nov., and such well may prove to be the case for the two Japanese species.

Key to the Indo- and Western Pacific species of *Porcellanopagurus*

1. Rostrum truncate **2**
— Rostrum triangular or subtriangular **4**

2. Second lateral carapace lobe fringed with long setae **3**
— Second lateral carapace not fringed with long setae ..... ***P. adelocercus***

3. First lateral carapace lobe with distal and median spinule; rostrum usually trilobed. Dactyls of ambulatory legs each with 10 or 11 corneous spines on ventral margin ..... ***P. haptodactylus*** sp. nov.
— First lateral carapace lobe with only distal spinule; rostrum not trilobed. Dactyls of ambulatory legs each with 7 corneous spines on ventral margin ..... ***P. truncatifrons***

4. Posterolateral projection of carapace acute, spinulose or spinose **5**
— Posterolateral projection of carapace bluntly rounded **8**

5. Rostrum obtusely triangular; shield length (including rostrum) slightly less to slightly more than shield width (including lateral projections) **6**
— Rostrum acutely triangular; shield length (including rostrum) considerably less than shield width (including lateral projections) ..... ***P. filholi***

6. Midpoint of rostrum distinctly produced, often giving quasi trilobed appearance **7**
— Midpoint of rostrum not distinctly produced, not giving quasi trilobed appearance ..... ***P. jacquesi***

7. Ventromesial surfaces of palms of both chelae thickly set with tufts of long setae. Propodi of ambulatory legs longer than dactyls ..... ***P. japonicus***

Source : MNHN, Paris

— Ventromesial surfaces of palms of both chelae not thickly set with tufts of long setae. Propodi of ambulatory legs approximately equal to length of dactyls ..... ***P. tridentatus***

8. Tergite of sixth abdominal somite divided into 4 subequal lobes **9**
— Tergite of sixth abdominal somite divided into 2 subequal lobes ..... ***P. nihonkaiensis***

9. Second lateral carapace lobes well developed, produced distinctly beyond lateral level of first **10**
— Second lateral carapace lobes not well developed, not produced distinctly beyond lateral level of first ..... ***P. chiltoni***

10. Ambulatory legs stout; propodi and carpi each with irregular rows of prominent often spinulose protuberances ..... ***P. edwardsi***
— Ambulatory legs slender; propodi and carpi without irregular rows of prominent often spinulose protuberances ..... ***P. belauensis***

Porcellanopagurus haptodactylus sp. nov.

Fig. 2

MATERIAL EXAMINED. — **New Caledonia**. MONTROUZIER EXPEDITION: stn 1250, Touho, 20°46.7'S, 165°13.7'E, 3-6 m, vase sableuse, 1.09.1993: 1 ♀ (1.4 mm) (MNHN-Pg 5861). — Stn 1318, Koumac, 20°41.4'S, 164°14.8'E, 20-30 m, reef outer slope, 24.10.1993: 1 ♂ (2.3 mm) (MNHN-Pg 5862).

TYPES. — The male from Stn 1318 is the holotype; the female from Touho is the allotype.

DESCRIPTION. — Anterior carapace (Fig. 2a) with shield length slightly shorter than maximum breadth; anterior margin between rostrum and lateral projections slightly concave; lateral carapace margins each with short acute spine in distal 0.35 of first lobe; roundly triangular, unarmed lobe at mid-length; moderately short, blunt, subacute or denticulate lobe posterior to cervical groove, median element very narrow; dorsal surface of shield strongly calcified, posterolateral regions weakly delineated; posterior margin truncate. Posterolateral plates weakly calcified, *cardiac sulci* and *sulci cardiobranchialis* extending nearly to posterior carapace margin; posteromedian plate not noticeably delineated. Rostrum well developed, broad, truncate or prominently trilobed (Fig. 2a-b), reaching considerably beyond bases of ocular peduncles. Lateral projections triangular; well developed but produced only to mid-rostral length.

Ocular peduncles short, stout, less than half length of shield, with submedian constriction; corneas slightly dilated, diameter approximately 0.5 length of peduncle. Ocular acicles very small, acutely triangular.

Antennular peduncles when fully extended, overreaching ocular peduncles by approximately 0.5 length of penultimate segment. Ultimate segment with few setae dorsally. Basal segment unarmed.

Antennal peduncles overreaching ocular peduncles by approximately 0.5 length of ultimate segment. Fifth and fourth segments with few scattered, short setae. Third segment unarmed. Second segment with dorsolateral distal angle produced, terminating acutely; dorsomesial distal angle rounded. First segment produced, unarmed or with tiny terminal spinule. Antennal acicle reaching to or beyond distal margin of fourth peduncular segment, terminating acutely and with few moderately long setae. Antennal flagella missing.

Thoracic sternites 3-8 (Fig. 2c) unarmed. Sternite of third maxillipeds (third thoracic) bluntly triangular on either side of median concavity. Sternite of chelipeds with left side enlarged, partially fused with sternite of second pereopods. Sternite of second pereopods broad, plate-like, with incomplete median longitudinal groove. Sternite of third pereopods with subrectangular anterior lobe. Sternite of fourth pereopods concealed from direct ventral view by sternite of third. Sternite of fifth pereopods narrow, well separated from preceding sternites.

Right cheliped (Fig. 2d) stout; longer and considerably stronger than left. Dactyl slightly shorter than palm; articulating obliquely; cutting edge with 3 or 4 calcareous teeth; terminating in small calcareous claw, slightly overlapped by fixed finger; dorsal surface convex, unarmed or minutely granular, dorsomesial margin with very low, minutely spinulose or denticulate ridge; ventral surface with few tufts of setae. Palm longer than carpus; somewhat

Source : MNHN, Paris

swollen dorsoventrally; dorsal surface convex, dorsomesial and dorsolateral margins slightly elevated, unarmed or minutely spinulose or scalloped; fixed finger with few tufts of short setae dorsally and ventrally; cutting edge with 2-4 distinct calcareous teeth. Carpus slightly longer than merus; dorsomesial and dorsolateral margins not distinctly delimited; lateral and mesial surfaces with low, weakly rugose or microscopically spinulose, transverse ridges extending onto dorsal surface. Merus broadly subtriangular; dorsal margin with several transverse ridges and

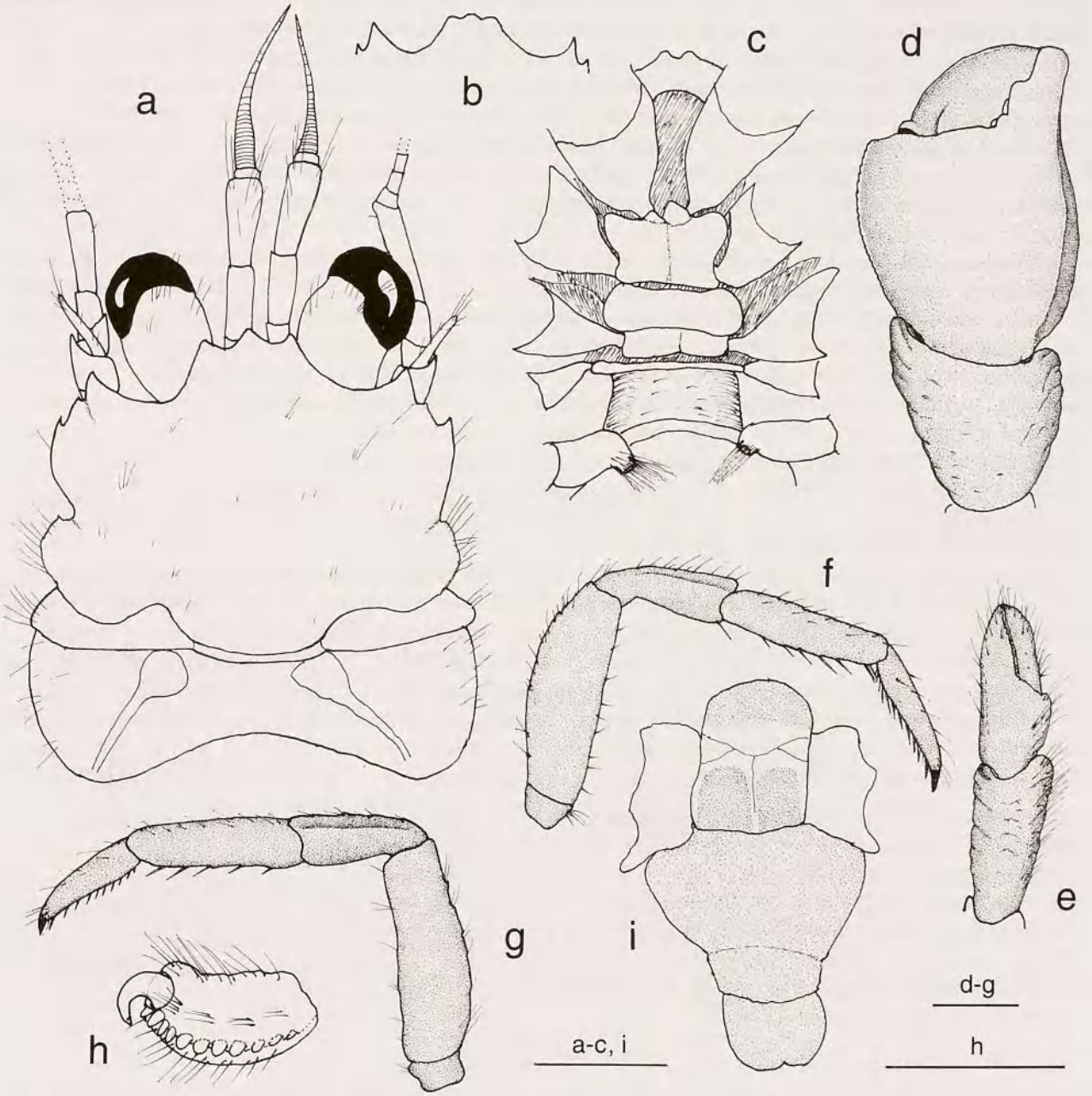

FIG. 2. — *Porcellanopagurus haptodactylus* sp. nov. a, c-i, holotype ♂ (2.3 mm) from Montrouzier Expedition Stn 1318; b, allotype (1.4 mm) from Montrouzier Expedition Stn 1250: **a**, cephalothorax and cephalic appendages (aesthetascs omitted); **b**, rostrum and anterior margin of shield; **c**, thorax (ventral view); **d**, carpus and chela of right cheliped (dorsolateral view); **e**, carpus and chela of left cheliped (dorsal view); **f**, right second pereopod (lateral view); **g**, left third pereopod (lateral view); **h**, propodus and dactyl of left fourth pereopod (lateral view); **i**, tergite of sixth abdominal somite, uropodal protopods, and telson. Scales equal 1 mm (a-g, i) and 0.5 mm (h).

Source : MNHN, Paris

few setae; ventromesial margin with 1 prominent tubercle or subacute spine at proximal angle; ventrolateral margin with row of few to several acute spines. Ischium with row of small spinules on ventromesial margin.

Left cheliped (Fig. 2e) with dactyl approximately 1.25 length of palm; cutting edge with row of corneous teeth; terminating in corneous claw and very slightly overlapped by fixed finger; dorsal surface unarmed or minutely granular, dorsomesial margin not delimited or microscopically serrate; mesial and ventral surfaces with numerous long setae. Palm approximately 0.5 length of carpus; dorsal surface smooth or microscopically granular, dorsolateral margin with row of very tiny spinules, dorsomesial margin unarmed or microscopically denticulate; ventral surface with scattered long setae; cutting edge of fixed finger with row of very small calcareous teeth, terminating in corneous claw. Carpus slightly longer than merus; dorsolateral surface with low transverse ridges, dorsal surface medianly with few low, short transverse ridges, in female forming longitudinal row of short rugose ridges; dorsomesial margin with very low granular or very weakly tuberculate ridge, mesial face with few short transverse low ridges and moderately long setae. Merus subtriangular; dorsal surface with few short transverse ridges and setae; ventromesial margin with 1 small spine adjacent to proximal angle; ventrolateral margin with row of widely-spaced stronger spines. Ischium with row of very small tubercles on ventromesial margin; row of small spines on ventrolateral margin.

Ambulatory legs (Figs 2f-g) moderately short; generally similar. Dactyls 0.60-0.75 length of propodi; in dorsal and lateral views, nearly straight; dorsal margins with moderately sparse setae; mesial and lateral faces with few short setae; ventral margins each with row of 9-11 corneous spines. Propodi equal to or slightly longer than carpi; dorsal surfaces with row of low protuberances and sparse setae; ventral margins each with row of 5-7 spinose setae. Carpi shorter than meri; dorsal margins with few low protuberances, no distinct spine at distal angle; lateral faces each with longitudinal ridge dorsally; ventrodistal margins each with spiniform seta. Meri with low protuberances on dorsal margins, ventral surfaces slightly oblique (mesial view), ventromesial margins unarmed; ventrolateral margin unarmed, but formed as distinct ridge. Fourth pereopods with dactyl articulating perpendicularly with lateral face of propodus (Fig. 2h). Propodus of fifth pereopods with small rasp of corneous scales.

Males with coxae of fifth pereopods (Fig. 2c) slightly asymmetrical, somewhat produced posteromedially, gonopores each masked by long setae, no sexual tubes.

Abdomen short, globular. Tergite of first abdominal somite subrectangular, membranous and weakly delineated. Tergites of somites 2 to 5 also membranous, moderately broad, weakly indicated. Tergite of sixth somite (Fig. 2i) partially calcified, divided into subrectangular anterior and somewhat broader subquadrate posterior lobes by transverse furrow, distal lobe with incomplete median longitudinal furrow. Uropods symmetrical; protopods each with posteriorly directed subacute protuberance. Tergite of telson (Fig. 2i) carried ventrally and not contiguous with posterior tergal margin of sixth somite; entirely membranous, with complete transverse suture separating poorly defined anterior portion from posterior portion; posterior lobes separated by small median cleft, terminal margins rounded, unarmed; anus terminal.

VARIATION. — As *P. haptodactylus* is known from only two specimens, it is not clear whether certain of the variations noted are size or sex related or both. Most noteworthy is the difference in the rostrum of the male holotype and female allotype. As may be seen in Figure 2a, the rostrum of the male is clearly trilobed, whereas that of the female (Fig. 2b) is only weakly produced medianly. The right chela of this much smaller female is considerably narrower, but the armature of both chelipeds is stronger. The tergal portion of the telson of the female is nearly contiguous with the tergite of the sixth abdominal sternite, while in the male it is widely separated by a membranous area. This type of separation was reported by McLAUGHLIN & HOGARTH (1998) to be size-related in the similar species, *P. adelocercus*.

COLOR. — Unknown.

HABITAT. — One specimen was accompanied by part of a bivalve mollusk shell.

DISTRIBUTION. — Known only from New Caledonia (East coast: Touho; West coast: Koumac); 3-30 m.

ETYMOLOGY. — The specific name is taken from the Greek *hapto* meaning grasp, and *daktylos*, meaning finger and denotes the very characteristic articulations of the dactyls of the fourth pereopods, clearly adapted for grasping the crab's carcinoecium.

Source : MNHN, Paris

REMARKS. — *Porcellanopagurus haptodactylus* is most closely allied to *P. truncatifrons* and *P. adelocercus*, sharing with both a truncated rostrum. While the rostrum of the holotype male more closely resembles that of *P. adelocercus* in being distinctly trilobed, the rostrum of the allotype female more closely approaches that of *P. truncatifrons*. It is probable that these rostral differences are size related, as MCLAUGHLIN & HOGARTH (1998) reported similar size-related rostral differences in the rostrums of *P. adelocercus*. From the limited data available, it would appear that the truncate rostrum of *P. truncatifrons* does not represent a subadult developmental condition. TAKEDA's (1981) specimen has a shield length greater than either specimen of *P. haptodactylus* and only 0.1 mm smaller than the largest specimen of *P. adelocercus*. *Porcellanopagurus haptodactylus* is also distinguished from *P. truncatifrons* by the smoother, less setose shield surface of the former species and the greater number of spines on the ventral margins of the ambulatory dactyls. Similarly, *P. haptodactylus* has a greater number of dactylar spines than is seen in *P. adelocercus*, and the carpus of the left cheliped is more strongly armed in the former species. Additionally, the length of the antennular peduncles is considerably greater in *P. haptodactylus*.

MCLAUGHLIN (1997) remarked that TAKEDA's [1981, Fig. 3(3)] illustration of the fourth pereopod of *P. truncatifrons* appeared to have been inverted, thus giving the appearance of a dorsally directed dactyl. Although the dorsally directed propodal rasp in TAKEDA's figure does suggest inversion, it is very possible that the author was trying to illustrate a dactyl articulated away from the plane of the propodus. A similar condition is seen in the dactyls of the fourth pereopods of *P. haptodactylus*, although the dactylar articulation is 90° from (perpendicular to) the plane of the propodus, not 180° as suggested by TAKEDA's description.

Porcellanopagurus filholi de Saint Laurent & McLaughlin, 2000

Fig. 3

Porcellanopagurus edwardsi - BORRADAILE 1916a: 97 [not *Porcellanopagurus edwardsi* Filhol, 1885b].
Porcellanopagurus sp., "probably *P. edwardsi*" - BORRADAILE, 1916b: 111, figs 1-13.
Porcellanopagurus edwardsi - BALSS, 1930: 196 (in part). — BENNETT, 1932: 470 (in part). — GORDAN, 1956: 339 (in part) (lit.). — ZARENKOV, 1990: 239 (in part).
Porcellanopagurus sp. - KENSLEY, 1977: 167, fig. 2.
Porcellanopagurus filholi de Saint Laurent & McLaughlin, 2000: 114, fig. 36, pl. 3, fig. 3.

MATERIAL EXAMINED. — **New Caledonia**. MUSORSTOM 4: stn CC 201, 18°55.8'S, 163°13.8'E, 490 m, 20.09.1985: 1 damaged (8.2 mm) (MNHN-Pg 5863).

South Africa. *"Mering Naude"*: stn 43, (north of Richards Bay, KwaZulu-Natal), 28°45.5'S, 32°24.5'E, 420-360 m, 29.05.1975: 1 ♀ (3.1 mm) (SAM 15302).

DIAGNOSIS. — Cephalothorax (Fig. 3a) strongly calcified; lateral margins each with 3 distinct lobular or wing-like processes: first lobe moderately broad, anteriorly flat or rounded with prominent spike-like or spiniform projection; acute or subacute triangular or subtriangular lobe at mid-length; and considerably larger, elongate, acute or subacute lobe posterior to cervical groove, median element not always clearly delineated; posteromedian and posterolateral plates weakly calcified, *sulci cardiobranchialis* and *cardiac sulci* not reaching to posterior carapace margin. Dorsal surface of shield and lateral processes marked by numerous short transverse low ridges fringed with setae (not illustrated). Rostrum triangular with short dorsal keel distally, separated from subacute, moderately short, lateral projections by straight or slightly concave anterior margin. Ocular peduncles short, stout. Antennular peduncles overreaching distal margins of corneas by 0.2-0.5 length of penultimate segment. Antennal peduncles overreaching distal margins of corneas by 0.25-0.65 length of ultimate segment.

Ischia of third maxillipeds each with prominent ovate patch of dense setae dorsolaterally. Thoracic sternites (Fig. 3b) with scattered very small protuberances or granules Sternite of third maxillipeds with u-shaped median cleft, flanked on both sides by pair of widely-separated small spines. Sternite of chelipeds with left side markedly larger, partially fused with subrectangular sternite of second pereopods. Sternite of third pereopods incompletely divided into anterior and posterior lobes. Sternite of fourth pereopods hidden from view beneath sternite of third. Sternite of fifth pereopods slender, rod-like, widely separated from fourth.

Source : MNHN, Paris

Chelipeds very unequal, right much stronger, although not appreciably longer. Dactyl of right cheliped with row of small granules or denticles in proximal 0.65 of dorsomesial margin; dorsal surface rounded, granular or minutely tuberculate and with sparse tufts of moderate to long setae, with short subacute ridge proximally. Palm with convex dorsal surface minutely granular, particularly in mesial half and with numerous sparse tufts of moderately long setae, dorsomesial margin with low ridge of tiny tubercles or simply crenulations, dorsolateral margin with distinct low ridge of crenulations or granules, becoming somewhat more prominent on fixed finger. Carpus somewhat roundly elevated in dorsal midline with several short transverse piliferous ridges, dorsomesial and dorsolateral margins and mesial and lateral faces each with transverse piliferous crenulated low ridges. Merus with row of moderately small spines on ventromesial and ventrolateral margins, ventral surface with very dense patch setae in mesial half.

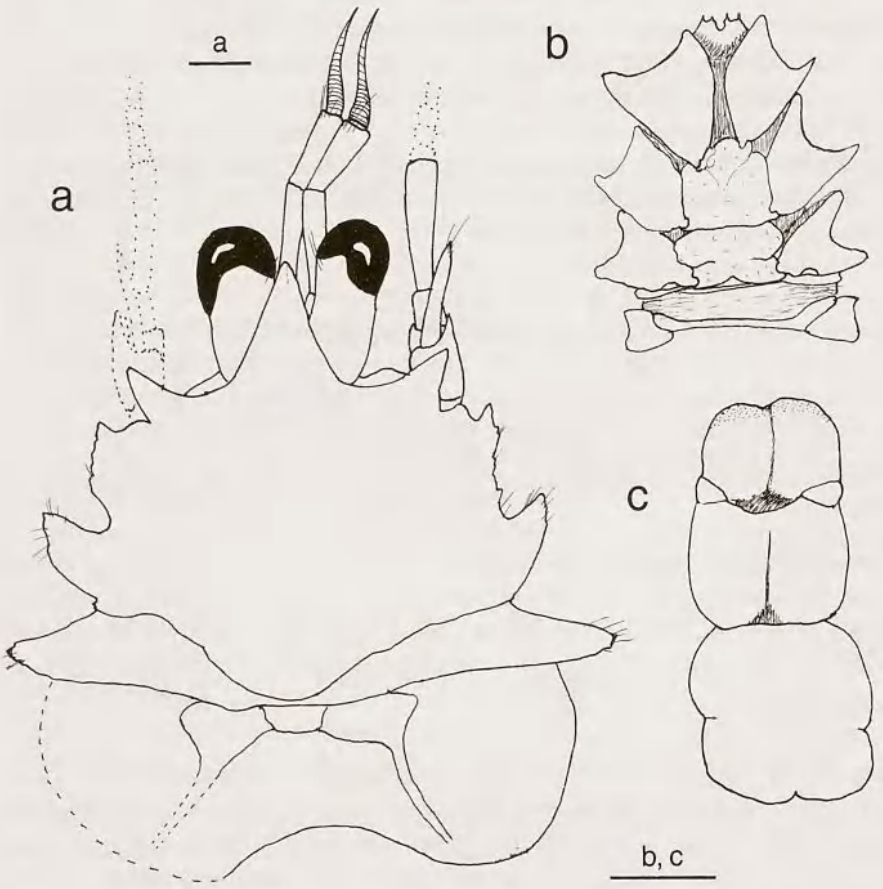

FIG. 3. — *Porcellanopagurus filholi* de Saint Laurent & McLaughlin, 2000. a, c, damaged ♂ (8.2 mm) from MUSORSTOM 4, Stn 201; b, ♀ (3.1 mm) from *"Mering Naude"* Stn 43: **a**, cephalothorax and cephalic appendages (aesthetascs omitted); **b**, thorax (ventral view); **c**, tergite of sixth abdominal somite and telson. Scales = 1 mm.

Left cheliped with surfaces of dactyl unarmed but with sparse tufts of setae adjacent to cutting edge and ventrally. Palm with minutely granular dorsal surface; dorsolateral margin only weakly delimited by very low granular ridge, not extending onto fixed finger; dorsomesial margin with granular ridge. Carpus with several transverse, weakly raised piliferous ridges; dorsomesial and dorsolateral margins each with low, transverse, somewhat crenulated ridges and sparse tufts of setae. Merus with row of small spines in proximal 0.65 of ventromesial margin; ventrolateral margin with row of smaller, more widely-spaced spines.

Ambulatory legs generally similar. Dorsal margins of dactyls each with sparse setae (second) or transverse rows of moderately long setae (third); ventral margins each with row of 8-13 corneous spines. Propodi with short somewhat denticulate ridges forming irregular longitudinal rows on dorsal surface and lateral and mesial faces dorsally, ventral margin with single or double row of long spiniform setae. Carpi each with dorsodistal spine, rows of denticulate protuberances on dorsal faces; lateral faces each with protuberances forming distinct ridge near mid-width and with few lower denticulate protuberances ventrally. Meri each with row of very small spines on ventrolateral margins; ventromesial margins minutely granular.

Males with coxae of fifth pereopods roundly subquadrate, gonopores each encircled by tuft of long setae. Tergite of sixth abdominal somite (Fig. 3c) divided into anterior and posterior halves by prominent transverse furrow, with small area of calcification laterally. Anterior and posterior portions each divided by longitudinal median furrow.

Source : MNHN, Paris

Telson (Fig. 3c) with small lateral indentations; posterior lobes separated by very minute median cleft, terminal margins rounded; anus opening very slightly anterior to terminal telson margins.

COLOR. — Ambulatory legs with broad red bands on cream background; carapace, rostral apex and ocular peduncles with red patches (after KENSLEY, 1977).

HABITAT. — Commonly found utilizing halves of bivalve shells, and occasionally limpets. Animals have been found with the telson and endopods of the uropods securely lodged in the umbos of the bivalves.

DISTRIBUTION. — Eastern South Africa, eastern Australia, New Zealand from north of Three Kings Islands south to off the Canterbury Bight, and east to the Chatham Islands, New Caledonia; 64-1392 m, possibly as deep as 1430 m.

REMARKS. — As pointed out by DE SAINT LAURENT & MCLAUGHLIN (2000), *Porcellanopagurus filholi* has, for many years, been confounded with *P. edwardsi*. *Porcellanopagurus filholi* is most easily disitnguished from *P. edwardsi* by the bilobed first lateral carapace process, and shorter, stouter ambulatory legs of the latter species.

Porcellanopagurus sp. of KENSLEY (1977), a female with regenerating chelipeds has been reexamined and can be assigned to *P. filholi*. Although KENSLEY cited the specimen as a male in his material examined, in his station data it is listed as a female, and his discussion and illustration correctly indicate female. This specimen, from north of Richards Bay, KwaZulu-Natal, South Africa, extends the range of this species.

Porcellanopagurus tridentatus Whitelegge, 1900

Fig. 4

Porcellano-pagurus tridentatus Whitelegge, 1900: 181, figs 13-13b.
Porcellanopagurus tridentatus - TAKEDA, 1985: 141. — TÜRKAY, 1986: 140. — SUZUKI & TAKEDA, 1987: 17. — ZARENKOV, 1990: 239. — DE SAINT LAURENT & MCLAUGHLIN, 2000: 106, fig. 33.
Not *Porcellanopagurus tridentatus* - CHILTON, 1911: 352 (= *Porcellanopagurus chiltoni* de Saint Laurent & McLaughlin, 2000).

MATERIAL EXAMINED. — **New Caledonia**. BIOCAL: stn DW 64, 24°48'S, 168°09'E, 250 m, 3.09.1985: 2 ♂ (2.7, 3.7 mm), 1 ov. ♀ (3.2 mm) (MNHN-Pg 5864).

MUSORSTOM 4: stn DW 230, 22°52.5'S, 167°11.8'E, 390-420 m, 30.09.1985: 1 ♀ (3.4 mm), 1 ov. ♀ (5.3 mm) (MNHN-Pg 5865).

SMIB 2: stn DW 3, 22°56.0'S, 167°14.8'E, 428 m, 17.09.1986: 1 ♂ (5.8 mm) (NHM 1999.2169).

CHALCAL 2: stn CP 18, 24°47.0'S, 168°09.4'E, 274 m, 20.10.1986: 1 ♂ (4.7 mm), 1 ov. ♀ (4.3 mm) (USNM 276173). — Stn DW 69, 24°43.7'S, 168°07.9'E, 260 m, 27.10.1986: 1 ♀ (3.8 mm) (MNHN-Pg 5866). — Stn DW 71, 22°42.3'S, 168°09.5'E, 230 m, 27.10.1986: 1 ♂ (4.2 mm) (MNHN-Pg 5867).

BATHUS 2: stn DW 729, 22°52'S, 167°11'E, 400 m, 12.05.1993: 1 ♀ (5.3 mm) (MNHN-Pg 5868). — Stn DW 730, 23°02'S, 166°58'E, 397-400 m, 12.05.1993: 1 ♀ (3.0 mm) (MNHN-Pg 5869).

Chesterfield Islands. MUSORSTOM 5: stn DC 361, 19°52.5'S, 158°38.1'E, 400 m, 19.10.1986: 1 ♂ (6.8 mm) (MNHN-Pg 5870). — Stn DC 379, 19°53.2'S, 158°39.5'E, 370-400 m, 20.10.1986: 1 ov. ♀ (6.7 mm) (MNHN-Pg 5871).

DIAGNOSIS. — Anterior carapace (Fig. 4a) broad, smooth, with few scattered tufts of short setae; lateral margins each with slender acute spine on triangular or rounded first lateral lobe, slightly smaller spine distally and often 3 or 4 spinules laterally on short subtriangular prominence of second lateral lobe, and moderately strong subtriangular, spinulose projection posterior to cervical groove, median element very narrow; posteromedian plate partially calcified, posterolateral plates distinct, weakly calcified, *sulci cardiobranchialis* and *cardiac sulci* extending nearly to posterior carapace margin. Rostrum very broadly triangular and usually weakly trilobed, reaching nearly to mid-length of ocular peduncles, broad basally, narrowing abruptly in distal 0.24-0.35, terminating subacutely. Lateral projections prominent, acute, forwardly or slightly anterolaterally directed. Ocular peduncles moderately short and stout; corneas slightly dilated. Antennular peduncles when fully extended overreaching distal margins of corneas by approximately 0.25 length of penultimate segment. Antennal peduncles overreaching distal margins of corneas by 0.5-0.65 length of fifth segment.

Source : MNHN, Paris

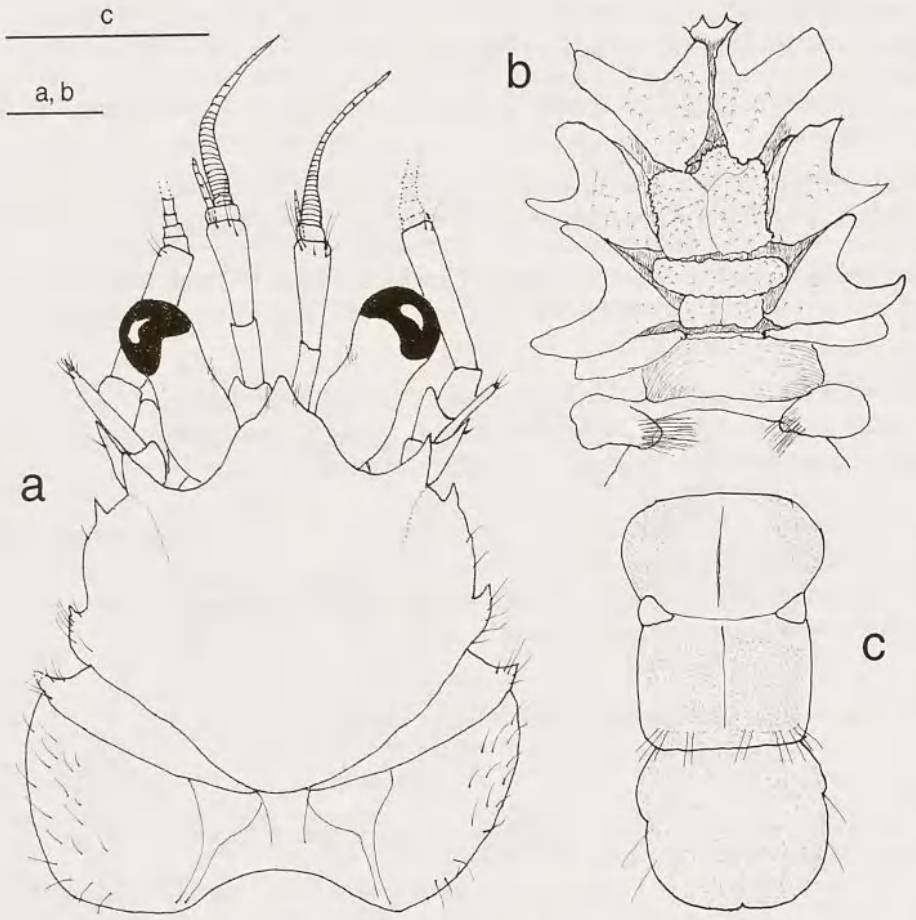

FIG. 4. — *Porcellanopagurus tridentatus* Whitelegge, 1900. a-c, ♂ (3.7 mm) from BIOCAL Stn DW 64: **a**, cephalothorax and cephalic appendages (aesthetascs omitted); **b**, thorax (ventral view); **c**, tergite of sixth abdominal somite and telson. Scales = 1 mm.

Ischium of third maxilliped without distinctive tuft of setae dorsolaterally. Thoracic sternites (Fig. 4b) with numerous scattered tubercles. Sternite of third maxillipeds with acute spine on either side of broad, u-shaped median cleft. Sternite of chelipeds largest on left side; incompletely fused to subquadrate sternite of second pereopods. Sternite of third pereopods with elongate subrectangular anterior lobe and shorter subrectangular posterior lobe. Sternite of fourth pereopods very slender, often obscured from view beneath third. Sternite of fifth pereopods slender, rod-shaped, well separated from fourth.

Right cheliped stout, considerably stronger, but not appreciably longer than left. Dactyl articulating somewhat obliquely with palm; dorsal and mesial surfaces rounded, granular or minutely tuberculate. Dorsomesial margin of palm with low tuberculate or granular ridge, dorsal surface granular or minutely tuberculate and with few scattered setae, dorsolateral margin with very faint granular ridge. Carpus trapezoidal, dorsomesial and dorsolateral margins and mesial and lateral faces dorsally with series of low, transverse protuberant ridges, strongest mesially. Merus without distinctive tuft of setae on ventromesial margin; ventrolateral and ventromesial margins each with row of small spines, strongest laterally.

Left cheliped with slight granular ridge on proximal half of dorsomesial margin of dactyl, dorsal surface with few very small tubercles in midline proximally. Palm with granular or minutely spinulose dorsal surface, dorsolateral margin with faint ridge. Carpus with mesial and lateral faces marked by low transverse ridges, forming longitudinal row on both dorsomesial and dorsolateral margins, strongest dorsomesially; dorsal surface with low, short transverse, sometimes granular or spinulose ridges. Merus with spinose ventromesial margin.

Ambulatory legs generally similar. Dactyls slightly shorter to slightly longer than propodi; each with 9-12 corneous spines on ventral margin. Propodi with low, sometimes spinulose protuberances on dorsal surfaces; lateral faces with short or very short transverse protuberances or ridges; ventral margins each with row of 5 or 6 spinose setae, longest distally. Carpi each with 1 or 2 irregular rows of blunt or spinulose protuberances on dorsal surfaces, dorsodistal spine sometimes slightly better developed; lateral faces each with prominent denticulate ridge in dorsal half and smaller ridges or low protuberances ventral. Meri each with row of spinules on ventromesial and ventrolateral margins, strongest laterally.

Coxae of fifth pereopods in males drawn out posteromedially and fringed with setae, but no membranous sexual tubes developed. Sixth abdominal somite (Fig. 4c) with prominent transverse suture at mid-length; anterior and

Source : MNHN, Paris

posterior lobes each incompletely divided by longitudinal grooves; marginal areas of anterior lobes and median portions of posterior lobes membranous; terminal margin entire. Telson (Fig. 4c) membranous; with slight lateral indentations; posterior lobes indicated by very slight median cleft; terminal margins unarmed; anus opening just anterior to terminal margins.

COLOR. — Unknown.

HABITAT. — Although most New Caledonian specimens were without any protective covering, three specimens carried limpet shells, while another utilized a bivalve shell.

DISTRIBUTION. — Eastern Australia, Norfolk and Kermadec Islands; New Caledonia; 99-250 m in Australian and New Zealand waters, 250-428 m in New Caledonia.

REMARKS. — DE SAINT LAURENT & MCLAUGHLIN (2000) discussed at length the inaccuracies in WHITELEGGE's (1900) original description as well as CHILTON's (1911) misidentification of material as *P. tridentatus*. DE SAINT LAURENT & MCLAUGHLIN (2000) described CHILTON's specimens as the new species, *P. chiltoni* de Saint Laurent & McLaughlin. The New Caledonia specimens differ from the lectotype of *P. tridentatus*, and from the other specimens examined by DE SAINT LAURENT & MCLAUGHLIN in having longer and slightly thinner ocular peduncles, and slightly longer antennular peduncles. One specimen showed only a hint of the somewhat trilobed rostrum characteristic of this species.

Porcellanopagurus chiltoni de Saint Laurent & McLaughlin, 2000

Fig. 5

Porcellanopagurus tridentatus - CHILTON, 1911: 352 (not *Porcellanopagurus tridentatus* Whitelegge, 1900).
Porcellanopagurus chiltoni de Saint Laurent & McLaughlin, 2000: 107, fig. 34.

MATERIAL EXAMINED. — **New Caledonia**. VOLSMAR: stn DW 48, 21°00.1'S, 170°03'E, 200 m, 4.07.1989: 1 ♂ (2.9 mm) (MNHN-Pg 5872).
SMIB 5: stn DW 99, 23°24.7'S, 168°05.4'E, 58 m, 14.09.1989: 1 ♂ (2.1 mm) (MNHN-Pg 5873).

DIAGNOSIS. — Cephalothorax (Fig. 5a) usually with denticulate scale-like protuberances, particularly on rostrum and laterally and anteriorly on shield. First lateral carapace lobe weakly produced, with small acute, subacute or blunt spine; second lateral carapace lobe not produced beyond lateral level of first, subtriangular, marginally denticulate; slightly stronger subtriangular, subacute projection posterior to cervical groove, median element very narrow; posteromedian plate not delineated, posterolateral plates weakly calcified, *sulci cardiobranchialis* and *cardiac sulci* reaching nearly to posterior carapace margin. Rostrum very broadly triangular, weakly, subacutely or acutely trilobed, reaching beyond mid-length of ocular peduncles. Lateral projections moderately short, subtriangular, anterolaterally directed, terminally acute or blunt. Ocular peduncles short, stout; with weak constriction adjacent to corneas. Antennular peduncles when fully extended overreach distal margins of corneas by slightly less to slightly more than full length of ultimate segment. Antennal peduncles overreaching distal margins of corneas by 0.25-0.75 length of ultimate segment.

Ischia of third maxillipeds usually without distinctive tuft of setae dorsolaterally. Thoracic sternites (Fig. 5b) slightly granular. Sternite of third maxillipeds bilobed, with anterior margins straight; small spinule on either side of v-shaped median cleft. Sternite of chelipeds with left side larger, incompletely fused to roundly subquadrate sternite of second pereopods. Sternite of third pereopods incompletely divided into anterior and posterior lobes; anterior lobe more elongate, posterior lobe with median indentation on posterior margin. Sternite of fourth pereopods very narrow. Sternite of fifth pereopods rod-shaped; considerably distant from fourth.

Right cheliped stout, considerably stronger than left. Dactyl with dorsal and mesial surfaces rounded, granular or minutely tuberculate, dorsomesial margin sometimes defined by faint ridge. Palm with dorsomesial margin marked by low tubercles or granules forming slightly elevated ridge, dorsal surface granular or tuberculate, sometimes with few scattered setae, dorsolateral margin with crenulate, granular, or minutely tuberculate ridge.

Source : MNHN, Paris

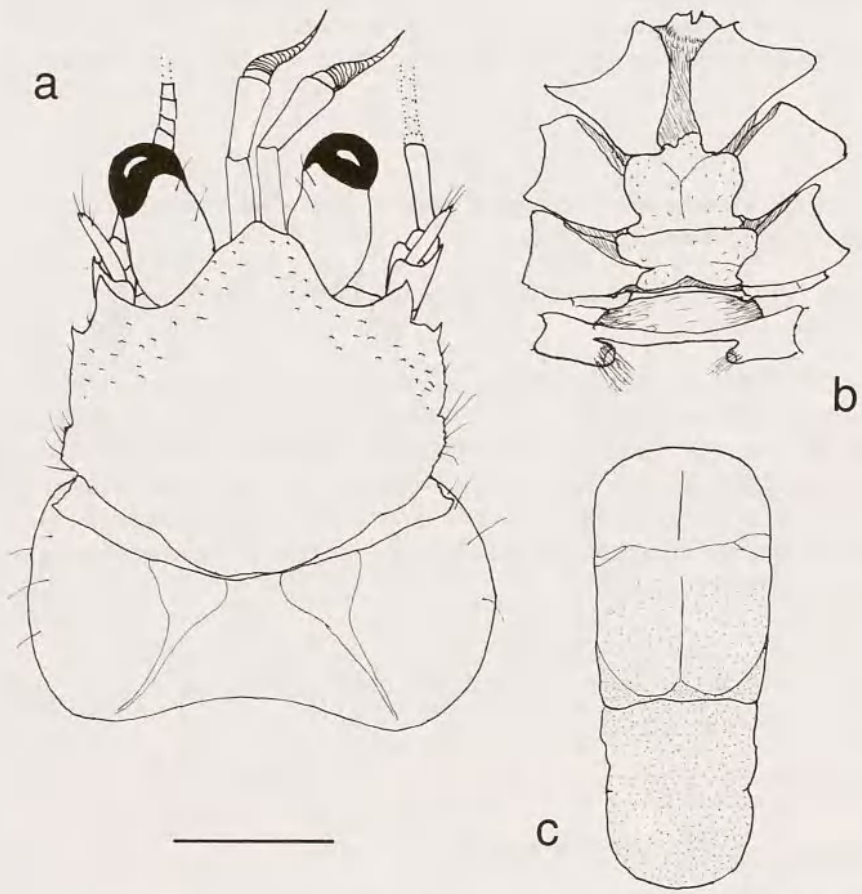

FIG. 5. — *Porcellanopagurus chiltoni* de Saint Laurent & McLaughlin, 2000. a-c, ♂ (2.1 mm) from SMIB 5 Stn DW 99: **a**, cephalothorax and cephalic appendages (aesthetascs omitted); **b**, thorax (ventral view); **c**, tergite of sixth abdominal somite and telson. Scale = 1 mm (a-b) and 0.5 mm (c).

Dorsomesial and dorsolateral margins of carpus and mesial and lateral faces dorsally with series of low transverse scale-like, granular or spinulose protuberant ridges, strongest mesially. Merus with few tiny spinules or tubercles on dorsodistal margin; without distinctive tuft of setae on ventromesial margin; ventrolateral and ventromesial margins each with row of subacute spines.

Left cheliped with row of very small tubercles on dorsomesial margin of dactyl; dorsal midline with short longitudinal row of tiny tubercles. Palm with covering of low tubercles or granules on dorsal surface not extending to distal half of fixed finger; dorsomesial and dorsolateral margins each with low spinulose or crenulate ridge. Carpus with transverse ridges forming longitudinal row on dorsomesial margin, dorsal surface with numerous scale-like tuberculate or spinulose, protuberant short ridges; mesial and lateral faces with low transverse ridges. Merus with row of subacute tubercles on ventromesial margin; ventrolateral margin with irregular double row of blunt or subacute spines or tubercles.

Ambulatory legs generally similar. Dactyls 0.75-0.85 length of propodi; dorsal surfaces with low protuberances and sparse setae; ventral margins each with 8-11 corneous spines. Propodi with numerous low, sometimes spinulose, protuberances on dorsal surfaces; ventral margins each with row of 5 or 6 long spiniform setae, and usually additional pair at ventrodistal margin. Carpi each with 1 or 2 irregular rows of spinulose protuberances on dorsal surface, no distinct dorsodistal spine; lateral faces each with prominent tuberculate or spinulose ridge in dorsal half and row of smaller ridges or low protuberances ventrally. Meri with ventromesial margins unarmed or granular; ventrolateral margins with 1 or 2 rows of spines or spinules.

Coxae of fifth pereopods in males slightly drawn out posteromedially and fringed with setae, but no sexual tubes developed. Sixth abdominal somite (Fig. 5c) with prominent transverse suture at or near mid-length; anterior and posterior lobes each incompletely divided by longitudinal groove; posterior lobes with subtriangular or ovate terminal margins and adjacent, sometimes well-calcified accessory plates. Telson (Fig. 5c) longer than broad, often membranous, with slight transverse indentation; rounded terminal margins with very slight median indentation; anus opening ventral to, but very near, terminal margin.

COLOR. — Unknown.

Source : MNHN, Paris

HABITAT. — Reportedly living under stones between the tidemarks in Kermadec Islands, and carrying half of a bivalve shell "or a vacant *Siphonaria* or limpet shell" (CHILTON, 1911).

DISTRIBUTION. — Kermadec Islands, New Zealand, intertidal; New Caledonia, 58–200 m.

REMARKS. — *Porcellanopagurus chiltoni* was described by DE SAINT LAURENT & MCLAUGHLIN (2000) from three specimens collected intertidally from the Kermadec Islands, New Zealand. As noted by these authors, this species bears considerable resemblance to *P. tridentatus*, but is distinguished by its longer antennular peduncles, shorter and stouter ocular peduncles, and most particularly by the distinct ovate appearance of the posterior lobes of the sixth abdominal tergite. Both species are reported for the Kermadec region, but with a distinct bathymetric separation. Although in New Caledonia *Porcellanopagurus chiltoni* occurs at considerably greater depths, i.e. 58-200 m, *P. tridentatus* similarly occupies a greater depth zone (250-428 m). Thus the bathymetric separation of the species appears to be maintained.

SOLITARIOPAGURUS Türkay, 1986

Solitariopagurus Türkay, 1986: 139. — POUPIN & MCLAUGHLIN, 1996: 212. — MCLAUGHLIN, 1997: 461.

TYPE SPECIES. — By original designation: *Solitariopagurus profundus* Türkay, 1986.

DIAGNOSIS. — Ten pairs of biserial phyllobranchiate gills. Anterior carapace vaulted and strongly calcified; lateral margins of shield developed into 3 blunt or spiniform lobes, posterior carapace lobe consisting of elongate median and small lateral elements; posterolateral and posteromedian plates usually well calcified; *sulci cardiobranchialis* and *cardiac sulci* usually not readily distinguishable. Rostrum and lateral projections widely separated. Ocular acicles reduced, simple; hidden from dorsal view. Maxillule with external lobe of endopod obsolete or absent. Third maxilliped with well developed crista dentata and 1 accessory tooth.

Right cheliped much stronger, but not appreciably longer than left. Ambulatory legs similar. Fourth and fifth pereopods subchelate.

Males with stout, moderately long, unequal sexual tubes developed as extensions of coxae of both fifth pereopods, right longest; each with long setae subterminally and terminally; no paired or unpaired pleopods. Females with single gonopore posteriorly on coxa of left third pereopod; no paired pleopods; unpaired left uniramous pleopods on abdominal somites 2-4.

Abdomen reduced; tergal plate of first somite chitinous or very faintly calcified; tergal plate of second weakly delineated; tergal plates of somites 3-5 clearly defined, chitinous or very weakly calcified; tergite of sixth somite weakly calcified, subdivided into narrow anterior transverse rod, and posterior pair of broad plates incompletely divided by median groove. Uropods symmetrical; protopods each with very prominent, posteriorly directed spine; exopods each with large, circular rasp of corneous scales; endopods each with ovate rasp of corneous scales. Telson with transverse suture or at least with distinct to weakly indicated mid-lateral indentation; terminal margin entire. Anus terminal or nearly so.

Key to the species of *Solitariopagurus*

1. Dorsal surface of carapace with transverse row of 4 distinct tubercles or spines proximal to anterior margin **2**
— Dorsal surface of carapace without transverse row of 4 distinct tubercles or spines proximal to anterior margin ..... ***S. profundus***

2. Rostrum triangular, terminating acutely or subacutely **3**
— Rostrum broad, "trowel-shaped" ..... ***S. trullirostris*** sp. nov.

Source : MNHN, Paris

3. Antennular peduncles overreaching ocular peduncles by 0.35–0.75 length of penultimate segment. Carpi of chelipeds, with slightly elevated and weakly armed longitudinal median crests on dorsal surfaces ..... ***S. triprobolus***
— Antennular peduncles overreaching ocular peduncles by length of ultimate segment or only slightly more. Carpi of chelipeds with row of spines or tubercles on prominent longitudinal crests on dorsal surfaces ..... ***S. tuerkayi***

Solitariopagurus trullirostris sp. nov.

Fig. 6

MATERIAL EXAMINED. — **New Caledonia**. Mbere Reef, 22°19.9'S, 166°13.2'E, 30 m, 7.01.1993: 1 ♂ (2.1 mm), 1 ov. ♀ (3.3 mm) (MNHN-Pg 5874).

Marquesas Islands. MUSORSTOM 9: stn DR 1259, 09°25.6'S, 140°08.3'W, 90-180 m, 3.09.1997: 1 immature ♀ (1.6 mm) (MNHN-Pg 5875).

TYPES. — The ovigerous female from Mbere Reef is the holotype; the male from the same locality is the allotype.

DESCRIPTION. — Shield (Fig. 6a) length shorter than breadth; anterior margin between rostrum and lateral projections straight or only very slightly concave; dorsal surface well calcified, with transverse row of 4 broad tubercles proximal to anterior margin; lateral margins each with relatively short, but prominent spiniform first lobe adjacent to anterolateral angle, broad, sometimes weakly bilobed second lobe at mid-length, and moderately slender subacute, somewhat hooked lobe adjacent to cervical groove; posterior margin roundly truncate. Posterior carapace with median element of posterior lobe moderately narrow, lateral elements subrectangular, unarmed; small posteromedian and posterolateral plates well calcified. Rostrum broad, roundly subacute, usually reaching to proximal 0.25 of ocular peduncles; slightly upturned, with elevated lateral margins. Lateral projections narrowly triangular; not as long as rostrum, directed anterolaterally.

Ocular peduncles laterally directed, slightly less than half shield length, with 3 prominent protuberances (not developed in immature specimen); corneas slightly dilated, diameter approximately 0.25 length of peduncle. Ocular acicles small, acutely triangular.

Antennular peduncles when fully extended exceeding length of ocular peduncles by almost entire length of ultimate segment. Ultimate segment with 2 or 3 long plumose setae on dorsodistal margin. Penultimate segment with few scattered short setae. Basal segment with tiny spinule on distolateral margin. Epistomial plate well calcified, broad, with pair of large subacute projections.

Antennal peduncles slightly shorter than ocular peduncles, and appreciably shorter than antennular peduncles. Fifth and fourth segments with few scattered, very short setae. Third segment unarmed. Second segment with dorsolateral distal angle produced, terminating in small spine or spinule; dorsomesial distal angle rounded. First segment with row of tubercles on ventrolateral margin. Antennal acicle moderately short, reaching nearly to or slightly beyond distal margin of fourth peduncular segment, terminating in tiny spinule, with 1 or 2 minute spinules on lateral margin. Antennal flagellum long, overreaching outstretched chelipeds, 1 or 2 short setae every 2 to 6 articles.

Thoracic sternites (Fig. 6b) smooth. Sternite of third maxillipeds produced into acute spinose process on either side of midline. Sternite of chelipeds moderately broad, subtriangular, surface concave, with blunt projection on either side of deep median groove. Sternite of second pereopods broad, plate-like, with faint median longitudinal groove. Sternite of third pereopods with narrowly subrectangular anterior lobe.

Right cheliped (Fig. 6c) elongate; considerably stronger but not appreciably longer than left; propodal-carpal articulation perpendicular. Dactyl slightly shorter than palm; cutting edge smooth or serrate and with 2 prominent calcareous teeth; terminating in small calcareous claw, slightly overlapped by fixed finger; dorsal surface convex, smooth or minutely granular, dorsomesial margin minutely serrate or tuberculate; ventral surface smooth or

Source : MNHN, Paris

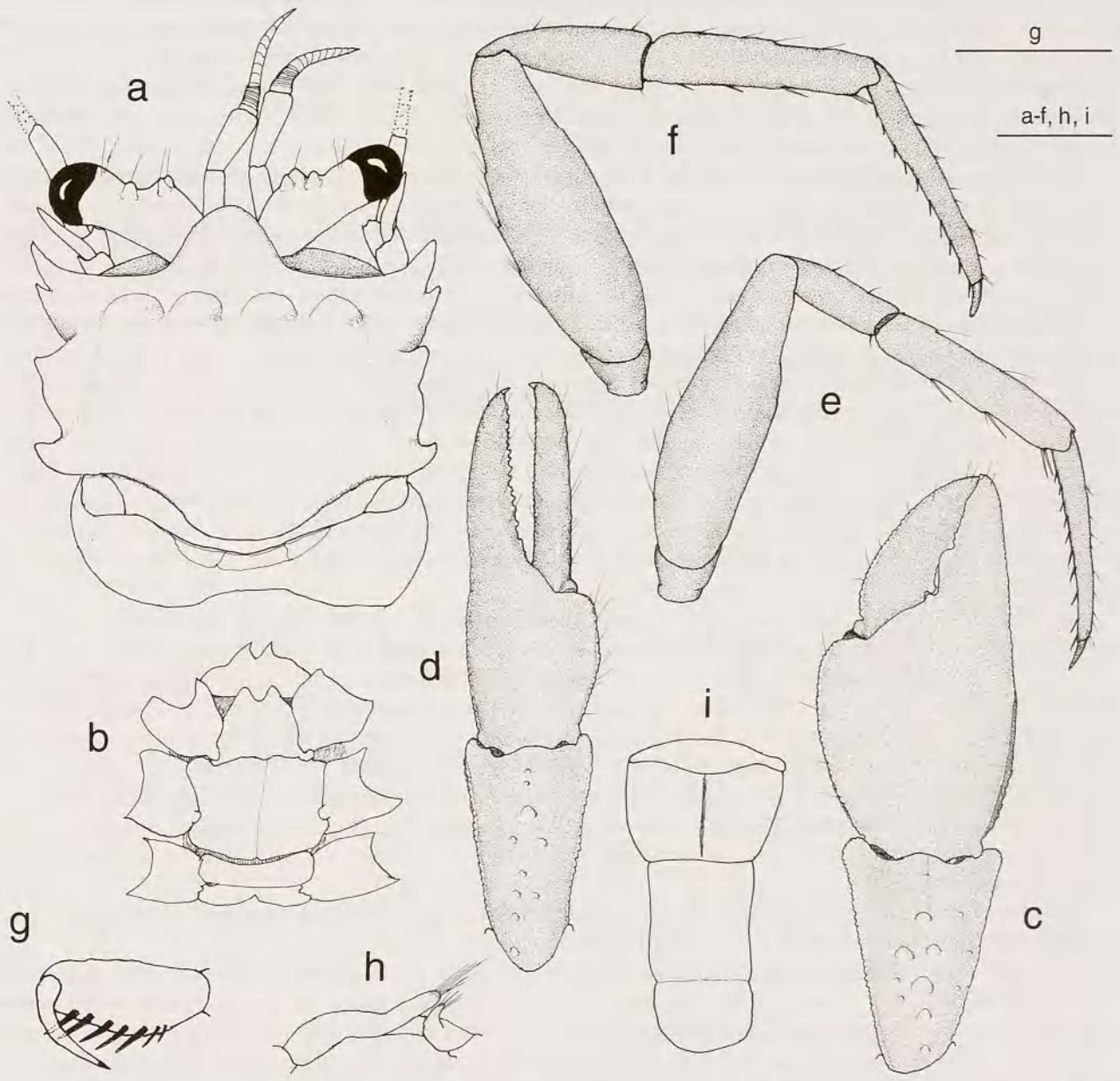

FIG. 6. — *Solitariopagurus trullirostris* sp. nov. a-i, holotype ♂ (2.1 mm) from Mbere Reef: **a**, cephalothorax and cephalic appendages (aesthetascs omitted); **b**, thorax (ventral view); **c**, carpus and chela of right cheliped (dorsolateral view); **d**, carpus and chela of left cheliped (dorsal view); **e**, right second pereopod (lateral view); **f**, right third pereopod (lateral view); **g**, propodus and dactyl of left fourth pereopod (lateral view); **h**, coxae and sternite of fifth pereopods; **i**, tergite of sixth abdominal somite and telson. Scales equal 1 mm (a-h), and 0.5 mm (i).

microscopically granular. Palm equal to or slightly longer than carpus; somewhat dorsoventrally compressed; dorsal surface convex, smooth or minutely granular; spinulose or serrate dorsomesial and dorsolateral margins slightly elevated; fixed finger also with smooth or minutely granular dorsal surface; cutting edge with 1 large and several smaller calcareous teeth; ventral surface of fixed finger with obliquely longitudinal spinulose or tuberculate ridge extending onto palm as row of distinct small spines; mesial face minutely spinulose. Carpus equal to or slightly longer than merus; trapezoidal (in dorsal view), with spinulose or tuberculate dorsomesial and dorsolateral margins slightly elevated; dorsal surface with irregular double median row of spinulose tubercles or blunt spines,

Source : MNHN, Paris

also with faint longitudinal ridge or crest, most distinct distally; mesial and lateral faces minutely granular or spinulose; ventral surface with numerous small spines, ventromesial and ventrolateral margins each with row of very small tubercles or blunted spines. Merus subtriangular; dorsal margin spinose or spinulose; lateral and mesial faces spinulose or granular; ventrolateral margin with row of small tooth-like spines, strongest proximally; ventromesial margin with row of small subacute spines, 1 prominent spine on ventral surface near mesioproximal margin. Ischium with row of small tubercles or spinules on ventromesial margin.

Left cheliped (Fig. 6d) with chela somewhat dorsoventrally compressed; dactyl and fixed finger curved ventrally. Dactyl 1.25 to 1.75 length of palm; cutting edge with row of very small calcareous teeth; terminating in corneous claw and very slightly overlapped by fixed finger; dorsal surface unarmed; dorsomesial margin serrate; mesial face and ventral surface each with few scattered moderately long setae. Palm approximately 0.75 length of carpus; dorsal surface smooth or minutely granular, dorsomesial and dorsolateral margins serrate and slightly elevated; ventral surface granular or minutely tuberculate, with short longitudinal row of small tubercles, ventral surface of fixed finger with longitudinal oblique row of minute spinulose tubercles; cutting edge of fixed finger with row of small calcareous teeth; terminating in corneous claw. Carpus approximately equal to length of merus; dorsal surface trapezoidal (dorsal view); dorsomesial and dorsolateral margins slightly elevated and minutely serrate, midline with single or irregularly double row of subacute tubercles; mesial and lateral surfaces smooth or minutely granular, ventromesial, ventrolateral and ventrodistal margins each with row of very small spines or spinules. Merus subtriangular; dorsal surface spinose or spinulose, mesial and lateral faces spinulose or tuberculate particularly near ventral margins; ventromesial margin with row of small tubercles; ventrolateral margin with row of spines, ventral surface with prominent spine at mesioproximal angle. Ischium with row of small tubercles or spines on ventromesial margin.

Ambulatory legs (Figs 6e-f) moderately long and slender; generally similar. Dactyls approximately equal to length of propodi; laterally compressed; dorsal margins with few scattered short setae; ventral margins each with row of 10 or 11 corneous spines. Propodi 1.25 to 1.5 length of carpi; dorsal margins each with few widely-spaced low protuberances; mesial and lateral faces unarmed; ventral margins each with 2 or 3 widely-spaced spiniform setae and 1 or 2 spiniform setae at distal angle. Carpi less than half length of meri; dorsal margins minutely granular, no distinct spine at distal angle. Meri with few low protuberances on dorsal margins, strongest on third pereopods; ventral surfaces oblique, ventromesial and ventrolateral margins microscopically tuberculate (not apparent in figures). Fourth pereopods strongly subchelate; propodal rasp (Fig. 6g) consisting of single row of spiniform corneous scales. Fifth pereopods weakly subchelate; dactyl and propodus each with small rasp of corneous scales dorsally.

Males with markedly unequal sexual tubes on coxae of fifth pereopods (Fig. 6h); each with terminal long setae. Females with uniramous, unpaired left pleopods on somites 2 to 4.

Abdomen with segmentation clearly delineated dorsally. Tergites 1-5 chitinous. Tergite of sixth somite with moderately well calcified anterior rod-like and posterior paired rectangular plates. Uropods symmetrical; protopods each with very strong, posteriorly directed subacute spine armed dorsally with few small spinules; exopods subcircular, each with large circular rasp of corneous scales; endopods appreciably smaller, roundly subrectangular, each with small rasp. Telson (Fig. 6i) with anterior lobes appearing to becoming more elongate with increasing size; complete, but very faint transverse suture separating membranous anterior and posterior lobes; terminal margin entire, with rounded external angles; anus terminal.

COLOR. — Unknown.

HABITAT. — Utilizing half of bivalve shell.

DISTRIBUTION. — Presently known from Mbere Reef in New Caledonia, and one locality in the Marquesas; 30-90, possibly as deep as 180 m.

ETYMOLOGY. — The specific name is taken from the Latin *trulla*, meaning trowel, and *rostrum*, and denotes the broad, trowel-like rostrum of this species.

REMARKS. — *Solitariopagurus trullirostris* sp. nov. shares with *S. triprobolus* and *S. tuerkayi* the distinctive character of four prominent tubercles on the anterior portion of the shield, an attribute that sets all three species

Source : MNHN, Paris

apart from *S. profundus*. However, *S. trullirostris* is immediately distinguished from all three other species by its broad, trowel-like rostrum.

Solitariopagurus triprobolus Poupin & McLaughlin, 1996

Fig. 7

Solitariopagurus triprobolus Poupin & McLaughlin, 1996: 212, figs 1-2. — McLaughlin, 1997: 464.

Material examined. — **New Caledonia**. Beryx 11: stn CP 23, 24°43.4'S, 168°07.8'E, 270-290 m, 17.10.1992: 1 ov. ♀ (3.8 mm) (MNHN-Pg 5876).

Chesterfield Islands. Musorstom 5: stn CP 287, 24°05.4'S, 159°36.5'E, 270 m, 10.10.1986: 1 ♂ (5.2 mm) (MNHN-Pg 5877).

Vanuatu. Musorstom 6: stn CP 455, 21°01'S, 167°26.1'E, 260 m, 20.02.1989: 1 ♀ (5.7 mm) (MNHN-Pg 5878).

Diagnosis. — Shield (Fig. 7a) shorter than broad, well calcified; dorsal surface with transverse row of 4 prominent, blunt or subacute spines proximal to anterior margin, sometimes 1 smaller spine anteriorly in midline near base of rostrum, and frequently additional small tubercles anteriorly and/or laterally; lateral margins each with prominent spinose first lobe at anterolateral angle, slightly shorter, simple or faintly bilobed, weakly serrate, or denticulate spinose second at mid-length and strong, often elongate and slender, usually anteriorly directed, spinose third lobe adjacent to cervical groove. Posterior carapace with median element of posterior lobe moderately broad, elongate, lateral elements, each armed with spine and/or projecting laterally as short, spinose process; posterolateral and posteromedian plates small, weakly to moderately well calcified. Rostrum triangular, elongate, usually reaching to distal half of ocular peduncles. Lateral projections extremely well developed, often reaching to or beyond tip of rostrum, directed anteriorly. Ocular peduncles moderately short. Antennular peduncles overreaching distal margins of corneas by at least 0.35 length of penultimate segment. Antennal peduncles overreaching distal margins of corneas by at least 0.25 length of ultimate segment. Sternite of chelipeds subtriangular, with terminal notch or indentation medially.

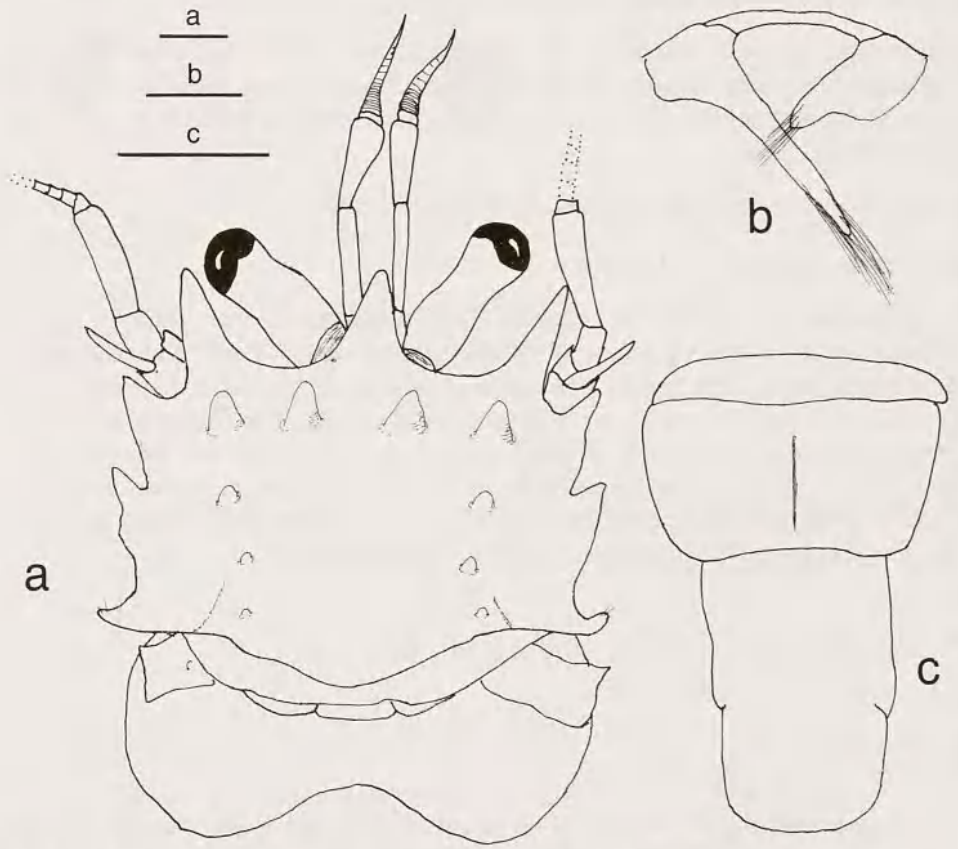

Fig. 7. — *Solitariopagurus triprobolus* Poupin & McLaughlin, 1996. a-c, ♂ (5.2 mm) from Musorstom 5 Stn CP 287: **a**, cephalothorax and cephalic appendages (aesthetascs omitted); **b**, coxae and sternite of fifth pereopods; **c**, tergite of sixth abdominal somite and telson. Scales = 1 mm.

Source : MNHN, Paris

Right cheliped stronger, but not appreciably longer than left. Dorsal surfaces of palm, fixed finger and dactyl, smooth or minutely granular. Carpus trapezoidal (in dorsal view), dorsomesial and dorsolateral distal angles frequently produced as wing-like projections; dorsal surface often with scattered small tubercles or spinules, also with median or submedian longitudinal row of tubercles, strongest in proximal half.

Left cheliped with dorsal surfaces of palm, fixed finger and dactyl smooth or minutely granular. Carpus frequently with scattered tubercles on dorsal surface; dorsomesial and dorsolateral distal angles often produced as wing-like projections, with raised, serrate dorsomesial and dorsolateral margins, midline with longitudinal row of simple or multidenticulate, spinulose tubercles or small spines, at least proximally.

Ambulatory legs long and slender; dactyls usually distinctly shorter than propodi, each with row of 9-17 corneous spines on ventral margin. Propodi with minutely granular or spinulose dorsal and ventral surfaces; ventral margins with 3 widely-spaced spiniform setae. Carpi with minutely granular or spinulose dorsal surfaces; lateral faces each with median longitudinal ridge and often longitudinal band of minute spinules. Meri with minutely granular of spinulose dorsal and ventral margins. Fourth pereopods each with row of 6-8 club-shaped corneous scales on ventral margin of propodus.

Male sexual tubes (Fig. 7b) weakly calcified. Telson (Fig. 7c) with anterior portion moderate to elongate; transverse suture weakly delineated; terminal margin entire, rounded; anus terminal or nearly so.

COLOR. — Overall generally orange-brown. Ocular peduncles with mesial and lateral longitudinal red stripe. Antennular peduncles with longitudinal red stripe dorsally. Ambulatory legs with three continuous or interrupted red stripes on lateral surfaces of meri; carpi often with one median longitudinal red stripe on lateral face and one on dorsal surface (POUPIN & MCLAUGHLIN, 1996).

HABITAT. — Usually utilizing halves of bivalve shells, occasionally univalve shells.

DISTRIBUTION. — French Polynesian islands; New Caledonia; 200-380 m.

REMARKS. — The small, ovigerous female from BERYX 11 station CP 23 resembles the male paratype figured by POUPIN & MCLAUGHLIN (1996, fig. 2A) in lacking accessory tubercles on the carapace and in having shorter lateral projections and lateral carapace spines. Additionally, the ocular peduncles are shorter and stouter in this specimen than seen in most representatives of the species; however, this development of the ocular peduncles is not an uncommon characteristic of smaller specimens of many species. In these respects, this specimen approximates *S. tuerkayi*; but is distinguished from that species by its longer antennular peduncles, and more anteriorly directed lateral projections. Although the right cheliped is missing, the armature of the carpus of the left cheliped agrees with that of the other specimens of *S. triprobolus* found in New Caledonia.

Solitariopagurus tuerkayi McLaughlin, 1997

Fig. 8

Porcellanopagurus sp. - TUDGE, 1995: 256, fig. 1G.
Solitariopagurus tuerkayi McLaughlin, 1997: 461, fig. 8.

MATERIAL EXAMINED. — **Okinawa**. 26°30'N, 127°50.9'E, 61-65 m, collector R.F. BOLLAND: 1 ov. ♀ (2.9 mm) (USNM 276172).
New Caledonia. BATHUS 1: stn 684, 20°34'S, 165°07'E, 110-130 m, 16.03.1993, 1 ♂ (2.1 mm) (MNHN-Pg 5879).

DIAGNOSIS. — Shield (Fig. 8a) length shorter than breadth; dorsal surface with transverse row of 4 moderately low, narrow to broad tubercles proximal to anterior margin; posterolateral region weakly delineated and usually somewhat globular; lateral margins each with relatively short, but prominent spinose first lobe adjacent to anterolateral angle, slender or broad, simple or weakly bilobed, acute or subacute spinose second lobe at mid-length, and short, broad or moderately slender spinose third lobe adjacent to cervical groove; posterior margin broadly rounded. Posterior carapace (damaged in New Caledonia specimen) with posterior lobe consisting of

Source : MNHN, Paris

moderately slender median element and pair of unarmed lateral elements, sometimes projecting as short blunt or spinose processes; posterolateral and posteromedian plates not delineated or sometimes very weakly calcified. Rostrum elongate, usually reaching to proximal half of ocular peduncles; broad, usually terminating bluntly. Lateral projections triangular; moderately elongate, slightly shorter to slightly longer than rostrum, directed anterolaterally. Ocular peduncles short or moderately short, corneas somewhat dilated. Antennular peduncles when fully extended, elongate, overreaching ocular peduncles by full length of ultimate segment to 0.25 of penultimate segment. Antennal peduncles overreaching ocular peduncles by 0.1 to 0.5 length of ultimate segment.

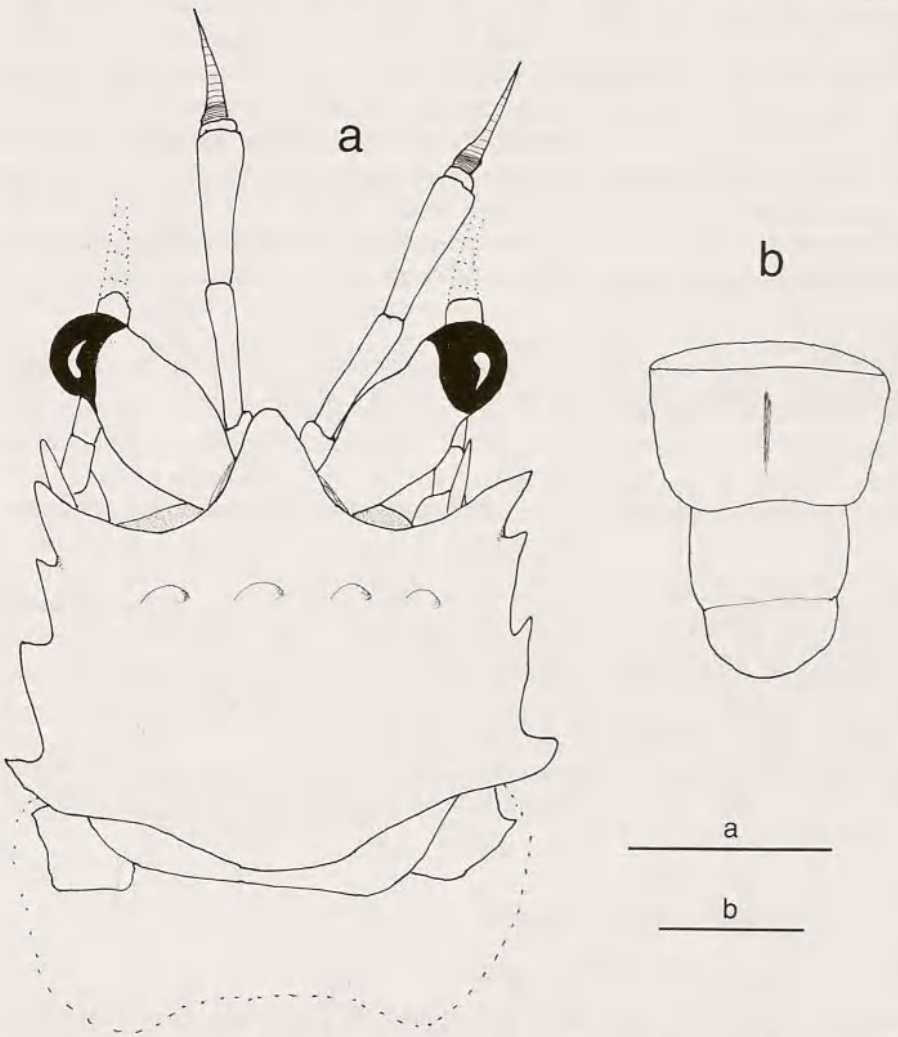

FIG. 8. — *Solitariopagurus tuerkayi* McLaughlin, 1997. a, ♂ (2.1 mm) from BATHUS 1 Stn 684; b, ov. ♀ (2.9 mm) from Okinawa: **a**, cephalothorax and cephalic appendages (aesthetascs omitted); **b**, tergite of sixth abdominal somite and telson. Scales = 1 mm (a) and 0.5 mm (b).

Right cheliped elongate; considerably stronger than left. Dactyl with dorsal surface convex, smooth or minutely granular, dorsomesial margin minutely serrate; ventral surface smooth or microscopically granular. Palm with dorsal surface convex, smooth or minutely granular; spinulose or serrate dorsomesial and dorsolateral margins slightly elevated; fixed finger also with smooth or minutely granular dorsal surface; ventral surface of fixed finger with obliquely longitudinal and microscopically tuberculate ridge extending onto palm in distal half. Carpus with spinulose dorsomesial and dorsolateral margins slightly elevated; dorsal surface with scattered small tubercles or spinules, also with longitudinal median ridge or crest, most distinct distally and armed with spinules or tuberculate spines, one strongest in proximal half; mesial and lateral faces minutely granular or spinulose; ventromesial and ventrolateral margins each with row of very small tubercles or blunted spines. Merus with row of small spines on ventrolateral margin strongest proximally; ventromesial margin with row of small spines distally, 3 or 4 very prominent spines proximally.

Left cheliped with dorsal and ventral surfaces of dactyl unarmed; dorsomesial margin serrate, at least in proximal half. Palm with dorsal surface smooth or minutely granular, dorsomesial and dorsolateral margins serrate and slightly elevated; ventral surface granular or minutely tuberculate, with short distal longitudinal row of small tubercles extending onto proximal half of fixed finger. Carpus with few scattered very small tubercles or spinules; dorsomesial and dorsolateral margins raised and serrate, midline with somewhat elevated crest armed with row of

Source : MNHN, Paris

simple or multidenticulate spinulose tubercles or small spines, strongest proximally, and with 1 very prominent tuberculate spine at mid-length; mesial, lateral, and ventral surfaces spinulose or tuberculate, ventrodistal margin with row of tubercles. Merus with row of small spinules, becoming strong spines proximally on ventromesial margin; ventrolateral margin minutely spinulose distally becoming row of stronger spines in proximal half.

Ambulatory legs moderately long and slender; generally similar. Dactyls approximately equal to length of propodi; dorsal margins with few scattered short setae; ventral margins each with row of 9 to 12 corneous spines. Propodi with serrate dorsal margins; mesial and lateral faces minutely spinulose, particularly ventrally; ventral margins each with 1 or 2 corneous spiniform setae at distal angle and 2 additional widely-spaced on ventral margin. Carpi with dorsal margins minutely serrate, no distinct spine at distal angle; lateral faces each with dorsal and median longitudinal ridges separated by concavity, most distinct on third, and with numerous microscopic spinules in ventral halves. Meri with serrate or spinulose dorsal margins; ventromesial and ventrolateral margins spinulose.

Males with subequal or markedly unequal sexual tubes on coxae of fifth pereopods (missing in New Caledonia specimen); each with subterminal and terminal long setae. Abdomen (missing in New Caledonia specimen) reduced, segmentation clearly delineated dorsally. Tergite of sixth somite with moderately well calcified anterior rod-like and posterior paired rectangular plates. Telson (Fig. 8b) (missing in New Caledonia specimen) elongate; transverse suture clearly delineated; terminal margin entire, with rounded external angle; anus opening directly beneath terminal margin.

COLOR (in preservative). — After four years in alcohol only a faint orange tint remains on chelae and dactyls of ambulatory legs; propodi of ambulatory legs with one or two very faint bands (McLAUGHLIN, 1997).

HABITAT. — Unknown.

DISTRIBUTION. — Known from the Kai and Tanimbar Islands, Indonesia, New Caledonia and Okinawa; 61-212 m.

REMARKS. — In his study of the ultrastructure of spermatozoa in the Thalassinidea and Anomura, TUDGE (1995) utilized a specimen borrowed form the Muséum national d'Histoire naturelle, Paris, and incorrectly identified for him as *Porcellanopagurus* sp. Now, after personally examining the remaining cephalothorax, chelipeds and ambulatory legs, it has been possible to assign his specimen to *Solitariopagurus tuerkayi*. TUDGE's findings should now be referred to *Solitariopagurus* rather than *Porcellanopagurus*.

Among the collections of the former Smithsonian Oceanographic Center (SOSC) is an ovigerous female specimen collected in Okinawa that is also identifiable as *S. tuerkayi*. This specimen represents the first record of *Solitariopagurus* in the northern hemisphere.

DISCUSSION

The matter of the separation of the telson from the tergite of the sixth abdominal somite and the location of the anal opening require further commentary. In the course of crustacean development, somite addition occurs between the dignathan head and the telson (e.g. CALMAN,1909; ANDERSON, 1979). The telson is, by that criterion, not considered a true somite (McLAUGHLIN, 1980). However, SHAROV (1966) and BOWMAN (1971) contended that two types of non-homologous telsons occurred in crustaceans, one in which no appendages were present and the anus was subterminal, and a second in which the anus was terminal and caudal rami were present. These authors considered that the latter type of telson was actually a terminal (anal) body somite. Although SCHMINKE (1976), argued rather convincingly that BOWMAN's (1971) interpretation of the telson was incorrect, SCHRAM (1986) continued to make the distinction. According to BOWMAN (1971), while the anus may open distally on the ventral surface of the telson in decapods, no decapod has a terminal anus. To the contrary, in some species of *Porcellanopagurus* and *Solitariopagurus* the anus is clearly terminal, while nearly so in others. Consequently by SHAROV (1966), BOWMAN (1971) and SCHRAM's (1986) definition, the telson in at least certain species in these two genera would be the seventh, and anal, body somite, albeit lacking appendages. While SCHMINKE (1976) did

Source : MNHN, Paris

not address the condition in decapods, he did suggest that the position of the anus was not an important feature for the definition of the telson. As he noted, a change in the position of the anus is not an uncommon phenomenon and might even change within the same animal during the course of its development. ROBERTS (1972) clearly indicated in his description of the larval stages of *Porcellanopagurus edwardsi* that the anus was located anteriorly on the ventral surface of the telson. MCLAUGHLIN (in press) reported that the telson was still in an anteroventral position in the megalopa of this species, but shifted to a slightly more posterior position in the first crab stage. Thus it is obvious that a positional change does occur in *Porcellanopagurus*, and presumably does as well in *Solitariopagurus*.

A change in the position of the anus does not, in itself, fully explain its unusual migration to a terminal location, nor does it offer any exegesis for the apparent separation of the telson from the sixth somite. To submit an unequivocal explanation would require the examination of a complete series of juvenile crab stages, which unfortunately are not available. However, from the data now at hand, a possible scenario can be put forth. It would appear that, contrary to development in most other pagurids [e.g., *Pagurus kennerlyi* (Stimpson, 1864), cf. MCLAUGHLIN *et al.*, 1989] there is a marked shortening of the abdomen that accompanies the molt from megalopa to first crab stage in *Porcellanopagurus* (cf. MCLAUGHLIN, in press) and presumably also *Solitariopagurus* species. As a result, the existing abdominal tissues expand laterally, which accounts for the semi-globular shape of the abdomen. With increased animal size, abdominal growth appears to be somewhat volumetric. Such growth would explain the ostensible dorsal migration of the female pleopods and perhaps even the posterior shift of the anus. Although the telson is most commonly described simply in terms of its tergal structure, it is a body unit just as any thoracic or abdominal somite, but differing from a true somite in the absence of paired ganglia and appendages (ANDERSON, 1979). In *P. adelocercus* (cf. MCLAUGHLIN & HOGARTH, 1998, fig. 29), *P. haptodactylus* sp. nov. (Fig. 2i), and *S. trullirostris* sp. nov. (Fig. 6i), the tergite of the telson is no longer the posterior-most dorsal structure. It appears to almost "float" on the upper surface of an extended telsonal unit, with the anal opening becoming terminal.

An explanation of the separation of the telson and sixth abdominal somite it less straightforward, and may not be comparable in the two genera. In *P. adelocercus* and *P. haptodactylus* sp. nov. there is no clear indication that the tergite of the sixth somite is the most posterior part of that somite, whereas there is a clear delineation of the telsonal unit. Thus it appears as if there is additional posterior growth of the sixth somite beyond the calcified tergal plate in some *Porcellanopagurus* species. In contrast, it seems as though the additional growth occurs in the anterior portion of the telsonal unit, including the anterior lobes of the tergite in *Solitariopagurus trullirostris* sp. nov. That the telson is carried ventrally is probably associated with these phenomena and the actions of the uropods in holding the carcinoecia.

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Source : MNHN, Paris

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Source : MNHN, Paris

8

Crustacea Decapoda: Species of the genera *Crosnierita* Macpherson, 1998, *Munida* Leach, 1820, and *Paramunida* Baba, 1988 (Galatheidae) collected during the MUSORSTOM 9 cruise to the Marquesas Islands

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ABSTRACT

During the MUSORSTOM 9 cruise (August-September 1997) to the Marquesas Islands, galatheids belonging to the genera *Crosnierita* Macpherson, 1998 (one species), *Munida* Leach, 1820 (4 species, one of which is new) and *Paramunida* Baba, 1988 (one new species) were collected. The two new species, *Munida glabella* and *Paramunida echinata*, are described and illustrated. *M. glabella* is close to *M. pusiola* Macpherson, 1993 from the Philippines. It belongs to the group of small size species that have five spines on the lateral borders of the carapace posterior to the cervical groove, no spines on the second abdominal somite and the distolateral spine of the basal antennal segment shorter than the distomesial spine. *P. echinata* is close to *P. labis* Macpherson, 1996 from the Wallis and Futuna Islands. It is characterised by the absence of ridges on the thoracic sternites and the presence of a spinous process on the distomesial spine of the second antennal segment.

RÉSUMÉ

Crustacea Decapoda : Espèces des genres *Crosnierita* Macpherson, 1998, *Munida* Leach, 1820, et *Paramunida* Baba, 1988 (Galatheidae) récoltées durant la campagne MUSORSTOM 9 aux îles Marquises.

Lors de la campagne MUSORSTOM 9 (août-septembre 1997) aux îles Marquises, des galathéides appartenant aux genres *Crosnierita* Macpherson, 1998 (1 espèce), *Munida* Leach, 1820 (4 espèces dont 1 nouvelle) et *Paramunida* Baba, 1988 (1 espèce nouvelle) ont été récoltées. Les deux espèces nouvelles, *Munida glabella* et *Paramunida echinata*, sont décrites

MACPHERSON, E., 1999. — Crustacea Decapoda: Species of the genera *Crosnierita* Macpherson, 1998, *Munida* Leach, 1820, et *Paramunida* Baba, 1988 (Galatheidae) collected during the MUSORSTOM 9 cruise to the Marquesas Islands. *In*: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 21. *Mémoires du Muséum national d'Histoire naturelle*, **184**: 415-423. Paris ISBN 2-85653-526-7.

Source : MNHN, Paris

et illustrées. *M. glabella* est proche de *M. pusiola* Macpherson, 1993, des Philippines et appartient au groupe d'espèces de petite taille ayant cinq épines sur les bords latéraux de la carapace en arrière du sillon cervical, le deuxième segment abdominal sans épines, et l'épine distolatérale du segment antennulaire basal plus courte que la distomesiale. *P. echinata* est proche de *P. labis* Macpherson, 1996, des îles Wallis et Futuna; elle se caractérise par les sternites thoraciques sans stries et l'épine distomésiale du second segment antennaire avec un processus épineux.

INTRODUCTION

The species of the genus *Munida* Leach, 1820 and related genera from the Central Pacific are poorly known, although a few publications have been published in the last decades (BABA, 1981; ZARENKOV & KHODKINA, 1981; TITGEN, 1987; MACPHERSON & DE SAINT LAURENT, 1991; MACPHERSON, 1996; BABA & DE SAINT LAURENT, 1996; POUPIN, 1996). During the MUSORSTOM 9 cruise to the Marquesas Islands (RICHER DE FORGES *et al.*, 1999) in August-September 1997, some galatheids of the genera *Crosnierita* Macpherson, 1998, *Munida* Leach, 1820 and *Paramunida* Baba, 1988 were collected. The study of these specimens revealed the presence of one species of *Crosnierita*, four species belonging to the genus *Munida*, including a new species, and one new species of the genus *Paramunida*.

The types of the new species and other material have been deposited in the collections of the Muséum national d'Histoire naturelle, Paris (MNHN) and National Museum of Natural History, Washington (USNM). The samples without any registration are kept at the Muséum national d'Histoire naturelle, Paris.

Measurements given are of carapace length, excluding rostrum, and the terminology used mainly follows that used in previous publications (ZARIQUIEY ÁLVAREZ, 1952; MACPHERSON & DE SAINT LAURENT, 1991; MACPHERSON, 1994; BABA & DE SAINT LAURENT, 1996). Colour notes are taken from slides by P. LABOUTE.

COMBINED LIST OF STATIONS AND OF SPECIES OBTAINED PER STATION

Stn CP 1146. — 22.08.1997, 09°18.8'S, 140°06.2'W, 200 m: *C. yante, P. echinata.*
Stn CP 1148. — 22.08.1997, 09°18.9'S, 140°06.3'W, 300 m: *M. plexaura, P. echinata.*
Stn CP 1154. — 23.08.1997, 07°58.5'S, 140°43.7'W, 102 m: *P. echinata.*
Stn CP 1172. — 25.08.1997, 08°44.8'S, 140°15.3'W, 300-302 m: *P. echinata.*
Stn CP 1176. — 25.08.1997, 08°45.8'S, 140°14.5'W, 260 m: *P. echinata.*
Stn CP 1177. — 25.08.1997, 08°45.1'S, 140°14.1'W, 108-112 m: *M. glabella.*
Stn CP 1190. — 26.08.1997, 08°46.3'S, 140°07.2'W, 350 m: *P. echinata.*
Stn CP 1201. — 28.08.1997, 09°50.6'S, 139°09.2'W, 275-300 m: *P. echinata.*
Stn CP 1208. — 28.08.1997, 09°48.9'S, 139°09.5'W, 117 m: *M. glabella.*
Stn CP 1237. — 31.08.1997, 09°41.9'S, 139°03.6'W, 95-305 m: *C. yante.*
Stn CP 1238. — 31.08.1997, 09°41.4'S, 139°03.8'W, 280-370 m: *C. yante, P. echinata.*
Stn CP 1262. — 03.09.1997, 09°19.8'S, 140°08.3'W, 850-905 m: *M. typhle.*
Stn CP 1268. — 04.09.1997, 07°55.8'S, 140°42.6'W, 285-320 m: *M. tuberculata.*
Stn CP 1269. — 04.09.1997, 07°56.3'S, 140°43.3'W, 420-430 m: *M. tuberculata, P. echinata.*
Stn CP 1278. — 05.09.1997, 07°52.1'S, 140°38.6'W, 1000 m: *M. typhle.*
Stn CP 1282. — 07.09.1997, 07°51.7'S, 140°30.6'W, 416-460 m: *C. yante, M. plexaura, M. tuberculata.*
Stn CP 1287. — 07.09.1997, 07°54.5'S, 140°40.2'W, 163-245 m: *M. plexaura.*

Source : MNHN, Paris

SYSTEMATIC ACCOUNT

Genus ***CROSNIERITA*** Macpherson, 1998

Crosnierita yante (Macpherson, 1994)

Munida yante Macpherson, 1994: 555, figs 62, 97.
Crosnierita yante - Macpherson, 1998: 353.

Material examined. — **Marquesas Islands**. Musorstom 9: stn 1146, 200 m: 1 ov. ♀ 8.2 mm (MNHN-Ga 4352). — Stn 1237, 95-305 m: 7 ♂ 5.8 to 10.3 mm; 3 ov. ♀ 8.2 to 8.4 mm; 8 ♀ 5.0 to 6.4 mm (MNHN-Ga 4353). — Stn 1238, 280-370 m: 1 ♂ 10.3 mm; 3 ov. ♀ 7.5 to 9.3 mm; 1 ♀ 6.7 mm (USNM). — Stn 1282, 416-460 m: 2 ♂ 7.5 and 9.7 mm; 1 ov. ♀ 7.5 mm; 1 ♀ 7.4 mm (MNHN-Ga 4354).

Remarks. — At first, the species was originally known from the female holotype collected in New Caledonia from 400 m (Macpherson, 1994). A second specimen was collected later during the Smib 8 cruise (unpublished data) in 310-460 m depth. The specimens collected in the Marquesas Islands agree well with these two specimens.

Distribution. — New Caledonia from 310-460 m. The specimens from Marquesas Islands were collected in 95-460 m.

Genus ***MUNIDA*** Leach, 1820

Munida glabella sp. nov.

Fig. 1

Material examined. — **Marquesas Islands**. Musorstom 9: stn 1177, 108-112 m: 1 ov. ♀ 3.6 mm (MNHN-Ga 4355). — Stn 1208, 117 m: 1 ♂ 3.3. mm (MNHN-Ga 4373); 1 ov. ♀ 3.4 mm (MNHN-Ga 4356).

Types. — The ovigerous female of 3.4 mm (MNHN-Ga 4356) from stn 1208 (09°48.9'S, 139°09.5'W, 117 m) has been selected as the holotype, the other specimens are paratypes.

Etymology. — From the Latin diminutive of *glaber*, smooth, in reference to the smooth surface of the carapace and the small size of the species.

Description. — Carapace slightly longer than wide. Transverse ridges mostly interrupted, with dense, very short, non-iridescent setae and few long, iridescent setae. Main transverse striae on posterior part of carapace interrupted in cardiac region. Few scales and secondary striae between main striae. Scales on intestinal region absent. Gastric region with 5 pairs of epigastric spines. One parahepatic and one postcervical spine on each side. Frontal margins transverse. Lateral margins slightly convex. Anterolateral spine short, at anterolateral angle, not reaching level of sinus between rostrum and supraocular spines. Second marginal spine before cervical groove two times smaller than preceding one. Branchial margins with five spines. Rostrum spiniform, half as long as remaining carapace, slightly sinuous and horizontal. Supraocular spines reaching midlength of rostrum and not overreaching end of corneas, parallel, directed upwards.

Thoracic sternites smooth, without striae, granules or carinae. Anterior part of fourth sternite slightly narrower than third. Transverse ridges between fifth, sixth and seventh sternites obtuse, feebly granulated.

Second abdominal somite unarmed. Second and third somites each with one transverse stria. Fourth abdominal somite without stria.

Source : MNHN, Paris

Eyes moderately large, maximum corneal diameter about one-third distance between bases of anterolateral spines.

Basal segment of antennule (distal spines excluded), about one quarter carapace length, elongate, slightly overreaching corneae, with two distal spines, mesial spine slightly longer than lateral spine; two spines on lateral margin, proximal one short, located at midlength of segment, distal one long, overreaching distolateral spine.

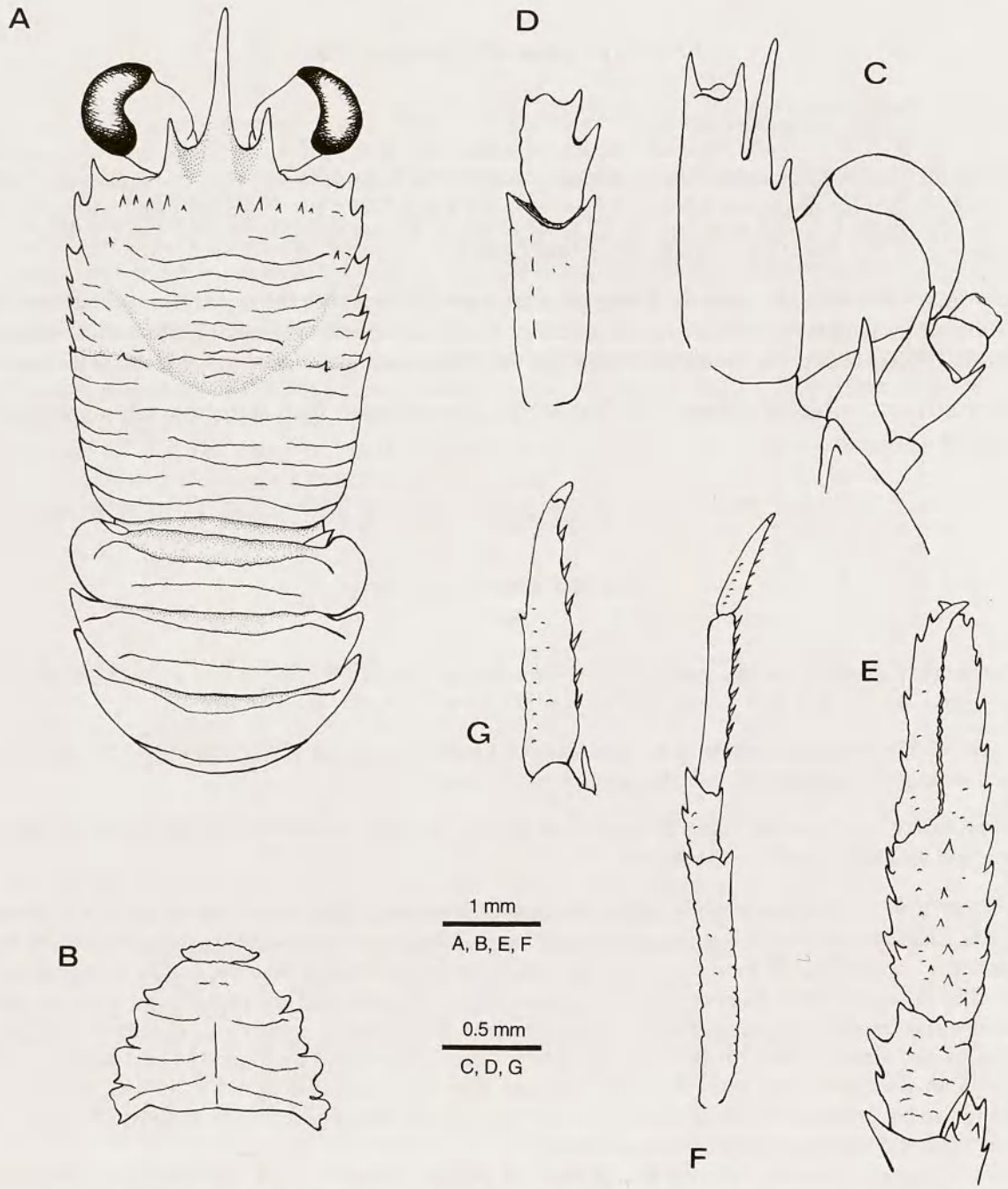

FIG. 1. — *Munida glabella* sp. nov., ov. ♀ 3.4 mm, holotype from stn 1208: **A**, carapace, dorsal view; **B**, sternal plastron; **C**, ventral view of cephalic region, showing antennula and antennal peduncles; **D**, right third maxilliped, lateral view; **E**, left cheliped, dorsal view; **F**, right first walking leg, lateral view; **G**, dactylus of right first walking leg, lateral view.

Source : MNHN, Paris

First segment of antennal peduncle with one distal spine on mesial margin nearly reaching end of second segment; second segment with two distal spines, mesial spine slightly longer than lateral spine, overreaching penultimate segment, although not overreaching antennal peduncle; penultimate segment unarmed.

Ischium of third maxilliped about 1.5 times length of merus measured along dorsal margin, distoventrally bearing spine. Merus of third maxilliped with two well developed spines on flexor margin, distal smaller; extensor margin with small distal spine.

Chelipeds subequal, squamous, with numerous short uniramous setae denser on mesial borders of articles. Palm slightly shorter than fingers. Merus armed with some spines, strongest spine on distal border short, not overreaching proximal quarter of carpus. Carpus with several spines on dorsal side and several spines scattered on mesial and ventral sides. Palm with several spines scattered on mesial and dorsal sides and one row of lateral spines, continuing onto along fixed finger. Fingers distally curving and crossing, ending in a sharp point; movable with some spines along mesial border; cutting edges with small teeth of different sizes.

Second pereiopod about twice carapace length; merus shorter than carapace, about 6 times as long as high, about 3 times carpus length and 1.5 times as long as propodus; propodus 5.5 times as long as high, about 1.5 times dactylus length. Merus with small spines on dorsal border, increasing in size distally, ventral margin with one long distal spine. Carpus with few dorsal spines and one distoventral spine. Propodus with 8-10 movable ventral spines. Dactylus with dorsal margin slightly convex on proximal half, slightly curving distally, with 6-7 movable spinules along entire ventral margin. Third pereiopod similar to second; fourth pereiopod shorter than second and third. Merus of fourth pereiopod 2/3 length of second pereiopod. Epipods absent from all pereiopods.

REMARKS. — *Munida glabella* belongs to the group of small species having five spines on the lateral margins of the carapace behind the cervical groove, moderately large eyes, an unarmed second abdominal somite, lateral parts of the posterior thoracic sternites without granules or carinae, spiniform rostrum, the distolateral spine of the basal antennular segment shorter than the distomesial, and the dactylus of the walking legs bearing movable spinules along the entire ventral border. The new species is closely related to *M. pusiola* Macpherson, 1993, from the Philippines (MACPHERSON, 1993).

However, the two species are distinguished by several characters:

— The frontal margins are clearly more oblique in *M. pusiola* than in the new species.

— The distal spines of the basal segment of the antennular peduncle are subequal in *M. pusiola*, whereas the distomesial spine is longer than the distolateral spine in the new species.

— The dactylus of the walking legs are as long or slightly shorter than the propodus in *M. pusiola*, but are about 2/3 propodus length in the new species.

Munida plexaura Macpherson & de Saint Laurent, 1991

Munida plexaura Macpherson & de Saint Laurent 1991: 396, fig. 7, pl. 1E. — POUPIN, 1996: 24, pl. 11a.

MATERIAL EXAMINED. — **Marquesas Islands**. MUSORSTOM 9: stn 1148, 300 m: 1 ♂ 6.1 mm; 1 juv. 5.0 mm (MNHN-Ga 4357). — Stn 1282, 416-460 m: 5 ♂ 8.8 to 13.2 mm; 1 juv. 6.0 mm (MNHN-Ga 4358). — Stn 1287, 163-245 m: 1 ♂ 12.6 mm (USNM).

DISTRIBUTION. — Previously known from French Polynesia: Tuamotu (Fakarava and Mururoa) and Tubuai (Raevavae) Islands in 350-398 m. The present material was collected from 163-460 m.

Munida tuberculata Henderson, 1885

Munida tuberculata - MACPHERSON, 1996: 408 (references); 1999: 424.

MATERIAL EXAMINED. — **Marquesas Islands**. MUSORSTOM 9: stn 1268, 285-320 m: 1 ov. ♀ 3.8 mm (MNHN-Ga 4359). — Stn 1269, 420-430 m: 1 ov. ♀ 6.8 mm (MNHN-Ga 4360). — Stn 1282, 416-460 m: 2 ♂ 4.3 and 5.0 mm (MNHN-Ga 4361).

Source : MNHN, Paris

DISTRIBUTION. — The species has previously been reported from Fiji, Vanuatu, New Caledonia, Matthew and Hunter Islands, Wallis and Futuna area, between 420 and 650 m. The material studied here was collected from 285-460 m.

Munida typhle Macpherson, 1994

Munida typhle Macpherson 1994: 549, fig. 60; 1999: 425.

MATERIAL EXAMINED. — **Marquesas Islands**. MUSORSTOM 9: stn 1262, 850-905 m: 1 ♀ 8.3 mm (MNHN-Ga 4362). — Stn 1278, 1000 m: 4 ♂ 4.5 to 5.7 mm; 2 ov. ♀ 5.4 and 6.7 mm; 3 ♀ 5.0 to 5.5 mm (MNHN-Ga 4363).

REMARKS. — The specimens from Marquesas Islands agree with the types and the material reported earlier from New Caledonia and Vanuatu. However, the small spines situated along the anterior ridge of the second abdominal somite may be absent in the specimens from Marquesas Islands (present in the type material).

DISTRIBUTION. — Previously known from New Caledonia and Vanuatu, between 1210 and 1470 m. The specimens from Marquesas Islands were collected from 850-1000 m.

Genus *PARAMUNIDA* Baba, 1988

Paramunida echinata sp. nov.

Fig. 2

MATERIAL EXAMINED. — **New Caledonia**. MUSORSTOM 9: stn 1146, 200 m: 17 ♂ 5.6 to 11.7 mm; 5 ov. ♀ 9.1 to 12.6 mm; 2 ♀ 7.8 and 8.5 mm (MNHN-Ga 4364). — Stn 1148, 300 m: 4 ♂ 9.3 to 10.6 mm; 3 ♀ 7.4 to 11.6 mm (USNM). — Stn 1154, 102 m: 1 ♂ 13.3 mm (MNHN-Ga 4365). — Stn 1172, 300-302 m: 3 ♂ 11.4 to 12.2 mm (MNHN-Ga 4366). — Stn 1176, 260 m: 17 ♂ 10.8 to 13.4 mm; 13 ov. ♀ 10.8 to 12.7 mm; 1 ♀ 9.1 mm (MNHN-Ga 4367). — Stn 1190, 350 m: 1 ♂ 15.5 mm (MNHN-Ga 4368). — Stn 1201, 275-300 m: 1 ♂ 13.4 mm (MNHN-Ga 4369). — Stn 1238, 280-370 m: 1 ♂ 6.8 mm (MNHN-Ga 4370). — Stn 1268, 285-320 m: 33 specimens (MNHN-Ga 4371). — Stn 1269, 420-430 m: 1 ♀ 6.9 mm (MNHN-Ga 4372).

TYPES. — The male 13.3 mm (MNHN-Ga 4365) from the stn 1154 has been selected as the holotype, the other specimens are paratypes.

ETYMOLOGY. — From the Latin *echinatus*, spiny, in reference to the presence of numerous spinules on the carapace and abdomen.

DESCRIPTION. — Carapace, excluding rostrum, as long as broad. Dorsal surface covered with numerous spinules. Gastric region with 3 well developed spines in midline. Cervical groove distinct. Cardiac region slightly circumscribed, with a median row of 3 well-developed spines, first slightly thicker than the others. Frontal margin transversal. Lateral margins convex, with some spines and iridescent setae on anterior half. Anterolateral spine well developed. Rostrum triangular; supraocular spines half as long and more slender than rostrum.

Fourth thoracic sternite with few arcuate striae; fifth to seventh smooth.

Abdomen with two median well-developed spines and one smaller lateral spine on each side on anterior and posterior ridges on second and third somites. Fourth abdominal somite similar to preceding, but posterior ridge with distinct single median spine. Some small spines and spiniform tubercles between median and lateral spines.

Eye large, maximum corneal diameter about 1/3 distance between bases of external orbital spines.

Basal segment of antennule (distal spines excluded) exceeding corneae, with distomesial spine shorter than distolateral. Anterior prolongation of first segment of antennal peduncle clearly overreaching antennular peduncle by about 1/4 of its length; second segment (spines excluded) about 2 times length of third segment and about 2 times longer than wide, distomesial spine slightly exceeding third segment, distally mucronated, distolateral spine not reaching end of third segment; third segment slightly longer than wide and unarmed.

Source : MNHN, Paris

Chelipeds and walking legs long and slender. First walking leg with propodus about 10 times as long as wide and more than 1.5 times dactylus length.

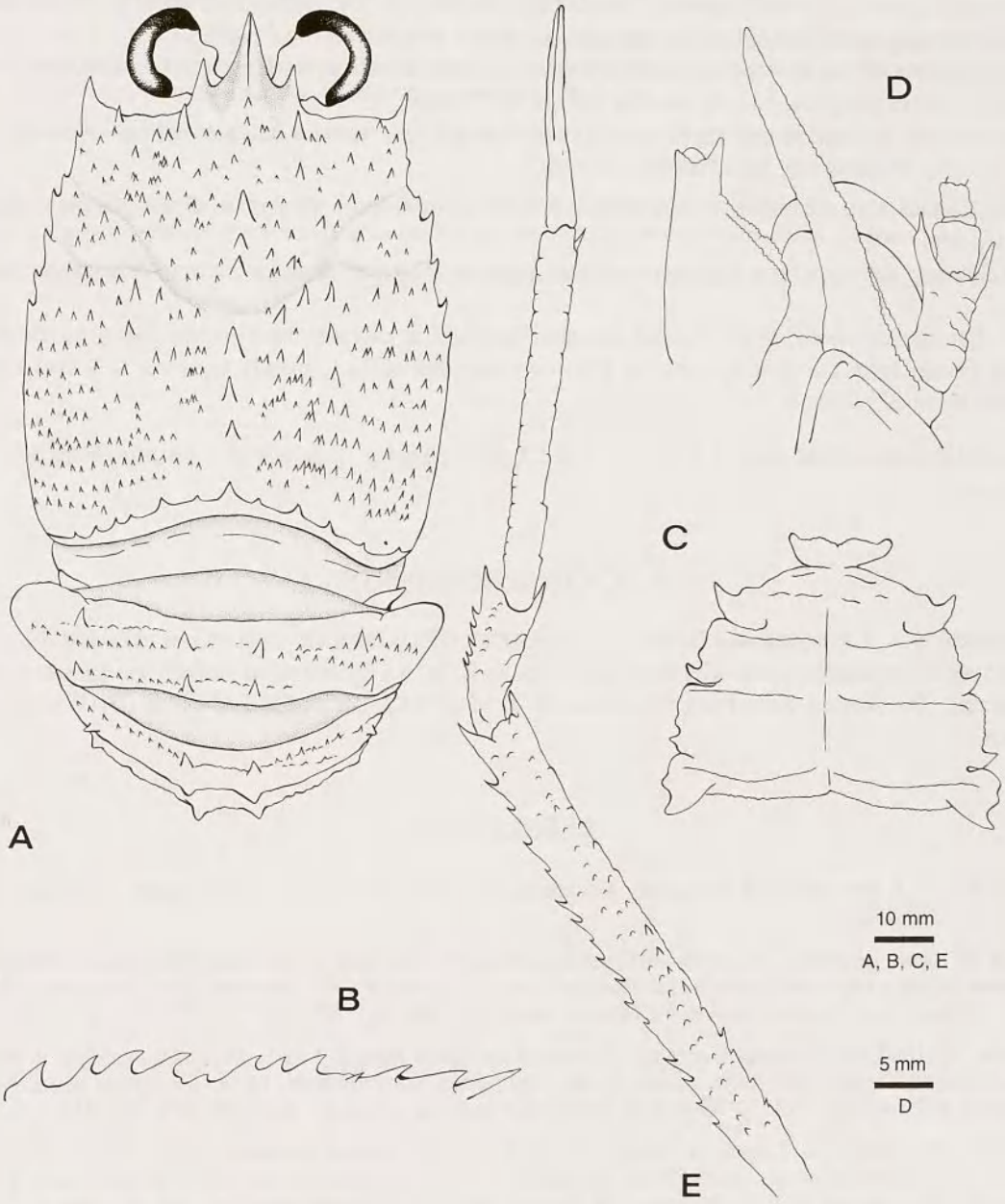

FIG. 2. — *Paramunida echinata* sp. nov., ♂ 13.3 mm, holotype from stn 1154: **A**, carapace, dorsal view; **B**, upper margin of carapace and rostrum, lateral view; **C**, sternal plastron; **D**, ventral view of cephalic region, showing antennula and antennal peduncles; **E**, right first walking leg, lateral view.

COLOUR. — Carapace and abdominal segments reddish; transverse rows of spinules red, with several white spots on cervical groove. Pereiopods whitish with numerous small red and white spots; chelipeds with reddish band on articulation of merus-carpus, carpus-propodus and hand-fingers. One specimen with a large transverse whitish band on gastric and anterior branchial regions.

Source : MNHN, Paris

REMARKS. — *Paramunida echinata* is closely related to *P. labis* Macpherson, 1996 from Wallis and Futuna Islands. Both species are characterized by having a rostral spine that is larger than the supraocular spines, the median gastric region bearing a row of 3-4 spines, the thoracic sternites smooth and the distomesial spine on the second antennal segment not evenly tapering, but distally mucronated. The two species differ in several characters:

— The rostrum is triangular in the new species, whereas it is spiniform in *P. labis*.

— The propodus of the walking legs is more than 1.5 times the dactylus length in the new species, whereas the propodi are slightly longer only than the dactyli in *P. labis*.

— The carapace and abdominal segments are reddish in the new species but with numerous small, white and yellow spots in *P. labis* (see MACPHERSON, 1996).

The new species also resembles *P. tricarinata* (Alcock, 1894) from the Indian Ocean, but they differ in the following aspects:

— The thoracic sternites have numerous arcuate striae in *P. tricarinata*; in the new species the sternites are smooth.

— The distomesial spine of the second antennal segment is distally mucronated and not overreaches the antennal peduncle in the new species; in *P. tricarinata* this spine is evenly tapering to a sharp tip, clearly exceeding antennal peduncle.

SIZE. — Males examined ranged from 5.6 to 14.3 mm; females from 6.8 to 12.8 mm. Females ovigerous from 9.1 mm.

ACKNOWLEDGEMENTS

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Source : MNHN, Paris

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Source : MNHN, Paris

Source : MNHN, Paris

9

Crustacea Decapoda : New species and new records of Ethusinae (Dorippidae) from Vanuatu

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ABSTRACT

During the MUSORSTOM 8 cruise in Vanuatu, in September and October 1994, 12 species belonging in the genera *Ethusa* and *Ethusina* were collected. Two of them, *Ethusina microspina* and *E. vanuatuensis*, are new; all the others are recorded for the first time in Vanuatu.

RÉSUMÉ

Crustacea Decapoda : Nouvelles espèces et nouvelles récoltes d'Ethusinae (Dorippidae) en Vanuatu.

Lors de la campagne MUSORSTOM 8 faite en Vanuatu en septembre et octobre 1994, 12 espèces appartenant aux genres *Ethusa* et *Ethusina* (Dorripidae) ont été récoltées. Deux de ces espèces, *Ethusina microspina* et *E. vanuatuensis*, sont nouvelles. Les dix autres sont mentionnées pour la première fois en Vanuatu.

This report is based on the samples collected in Vanuatu during the MUSORSTOM 8 cruise in September and October 1994. A total of 12 species belonging to 2 genera (*Ethusa* and *Ethusina*) of the subfamily Ethusinae have been identified, of which two species, *Ethusina microspina* and *Ethusina vanuatuensis*, are described as new. The other species are reported for the first time from Vanuatu.

Species of genus *Ethusa* were taken from depths of 180-956 m and those of the genus *Ethusina* from 437-1620 m.

CHEN Huilian (H. L. CHEN), 2000. — Crustacea Decapoda : New species and new records of Ethusinae (Dorippidae) from Vanuatu. *In*: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 21. *Mémoires du Muséum national d'Histoire naturelle*, **184**: 425-435. Paris ISBN 2-85653-526-7.

Contribution no. 3843, Institute of Oceanology, Chinese Academy of Sciences, Qingdao, China.

Source : MNHN, Paris

LIST OF SPECIES

Genus ***ETHUSA*** Roux, 1830
Ethusa furca Chen, 1993
Ethusa granulosa Ihle, 1916
Ethusa indica Alcock, 1896
Ethusa izuensis Sakai, 1937
Ethusa major Chen, 1993
Ethusa makasarica Chen, 1993
Ethusa minuta Sakai, 1937
Genus ***ETHUSINA*** Smith, 1884
Ethusina desciscens Alcock, 1896
Ethusina longipes Chen, 1987
Ethusina microspina sp. nov.
Ethusina robusta Miers, 1886
Ethusina vanuatuensis sp. nov.

SYSTEMATIC ACCOUNT

Subfamily ETHUSINAE Guinot, 1977

Genus ***ETHUSA*** Roux, 1830

Ethusa furca Chen, 1993

Ethusa furca Chen, 1993: 321, fig. 4.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: st. CP 980, 19°21.02'S, 169°25.22'E, 433-450 m, 22.09.1994: 1 ♂ 5.8 x 5.4 mm (MNHN-B 27493).

DISTRIBUTION. — New Caledonia and Vanuatu.

Ethusa granulosa Ihle, 1916

Ethusa granulosa Ihle, 1916: 143, fig. 76. — SERÈNE, 1968: 40. — CHEN, 1993: 323, fig. 5.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: st. DW 1046, 16°53.62'S, 168°11.08'E, 461-480 m, 30.09.1994: 1 ♀ 8.0 x 7.5 mm (MNHN-B 27494). — St. DW 972, 19°21.94'S, 169°28.07'E, 487-507 m, 20.09.1994: 1 ♀ 8.9 x 9.0 mm (MNHN-B 27495). — St. CP 975, 19°23.60'S, 169°28.93'E, 536-566 m, 22.09.1994: 1 ♂ 6.8 x 6.1 mm (MNHN-B 27496). — St. DW 1045, 16°54.50'S, 168°20.37'E, 459-488 m, 30.09.1994: 1 ♂ 8.9 x 8.1 mm (MNHN-B 27497).

DISTRIBUTION. — Indonesia, New Caledonia and Vanuatu.

Ethusa indica Alcock, 1896

Ethusa indica Alcock, 1894: 405; 1896: 283. — ALCOCK & ANDERSON, 1895, pl. 14 fig. 2. — IHLE, 1916: 136. — SAKAI, 1965: 24, pl. 11 fig. 4; 1976: 64, fig. 27. — SERÈNE, 1968: 40. — CHEN, 1985: 189, figs 8-9, pl. 1 fig. 1, pl. 2 fig. 5; 1986: 128, fig. 10(45-49); 1993: 324; 1997: 618. — DAI & YANG, 1991: 59, figs 27(3-4), pl. 6(4).
Ethusa gracilipes - SERÈNE & LOHAVANIJAYA, 1973: 35, figs 56-59, pl. 14 figs c-d. — SERÈNE & VADON, 1981: 119, 121 [Not *Ethusa (Ethusina) gracilipes* Miers, 1886].
Ethusa serenei Sakai, 1983: 4.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: st. CP 991, 18°51.26'S, 168°52.19'E, 910-936 m, 24.09.1994: 1 ♀ 12.0 x 12.5 mm (MNHN-B 27498). — St. CP 992, 18°52.34'S, 168°55.16'E, 748-775 m, 24.09.1994: 1 ♂ 10.8 x 11.5 mm; 1 ♀ 9.5 x 9.6 mm; 1 ovig. ♀ 11.6 x 12.5 mm (MNHN-B 27499). — St. CP 1007, 18°51.97'S, 168°55.92'E, 720-830 m, 25.09.1994: 1 ovig. ♀ 9.9 x 11.0 mm (MNHN-B 27500). — St. CP 1075, 15°53.26'S, 167°27.21'E, 944-956 m, 04.10.1994: 1 ♂ (broken); 3 ♀ 9.9 x 11.0 - 10.0 x 11.0 mm (MNHN-B 27501). — St. CP 1080, 15°57.30'S, 167°27.73'E, 799-850 m, 05.10.1994: 2 ♂ 8.3 x 8.0, 8.5 x 8.4 mm (MNHN-B 27502).

Source : MNHN, Paris

DISTRIBUTION. — East China Sea, South China Sea, Japon, the Philippines, Indonesia, New Caledonia and Vanuatu.

Ethusa izuensis Sakai, 1937

Ethusa izuensis Sakai, 1937: 80, fig. 4; 1965: 23, pl. 12 figs 1-2; 1976: 66, figs 26d, 29. — SERÈNE, 1968: 40. — TAKEDA & MIYAKE, 1972: 67. — SERÈNE & VADON, 1981: 119. — CHEN, 1985: 193, figs 11-12, pl. 1 fig. 2; 1986: 131, fig. 12(59-61); 1993: 324. — DAI & YANG, 1991: 58, figs 27(5-6), pl. 6(5).

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: st. DW 1060, 16°13.82'S, 167°20.80'E, 375-397 m, 02.10.1994: 1 juv. ♀ 4.6 x 4.8 mm (MNHN-B 27503).

DISTRIBUTION. — China, Japan, the Philippines, New Caledonia and Vanuatu.

Ethusa major Chen, 1993

Ethusa major Chen, 1993: 326, fig. 8.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: st. CP 1124, 15°01.72'S, 166°56.51'E, 512-599 m, 09.10.1994: 1 ♀ 15.5 x 15.0 mm (MNHN–B 27504).

DISTRIBUTION. — Coral Sea, Indonesia, Chesterfield Islands, New Caledonia and Vanuatu.

Ethusa makasarica Chen, 1993

Ethusa makasarica Chen, 1993: 327, fig. 9.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: st. CP 1124, 15°01.72'S, 166°56.51'E, 532-599 m, 09.10.1994: 4 ♂ 14.0 x 15.0 - 15.6 x 16.3 mm; 1 ♀ 17.5 x 19.0 mm (MNHN–B 27505). — St. 991, 18°51.26'S, 168°52.19'E, 910-936 m, 24.09.1994: 2 ♂ 14.0 x 15.0 mm; 16.0 x 17.5 mm (MNHN–B 27506).

DISTRIBUTION. — Indonesia and Vanuatu.

Ethusa minuta Sakai, 1937

Ethusa minuta Sakai, 1937: 81, pl. 11 fig. 2; 1965: 23, pl. 11 fig. 4. — CHEN, 1985: 193, figs 11-12, pl. 1 fig. 2; 1986: 131, figs 12(55-58); 1993: 329, fig. 10. — TAKEDA & MIYAKE, 1972: 68. — DAI & YANG, 1991: 58, figs 27(1-2), pl. 6(3).

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: st. 1071, 15°36.63'S, 167°16.34'E, 180-191 m, 04.10.1994: 1 ♂ 4.0 x 4.0 mm (MNHN-B 27507). — St CP 963, 20°20.10'S, 169°49.08'E, 400-440 m, 21.09.1994: 2 ♂ 9.0 x 8.7, 7.7 x 7.3 mm (MNHN-B 27508).

DISTRIBUTION. — East China Sea, Japan, the Philippines, Indonesia, Coral Sea, Chesterfield Islands, New Caledonia and Vanuatu.

Genus *ETHUSINA* Smith, 1884

Ethusina desciscens Alcock, 1896

Ethusina desciscens Alcock, 1896: 286. — ALCOCK & MCARDLE, 1903: pl. 2 figs 2-2a. — CHEN, 1985: 197; 1986: 136, figs 15(71-73); 1987: 689, fig. 7, pl. 2 F.

Source : MNHN, Paris

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: st. CP 1109, 14°52.20'S, 167°18.00'E, 1550-1620 m, 08.10.1994: 1 ♀ 10.7 x 10.3 mm (MNHN-B 27509).

DISTRIBUTION. — Madagascar, Laccadive Sea, Andaman Sea, Indonesia, the Philippines, China, Vanuatu.

Ethusina longipes Chen, 1987

Ethusina longipes Chen, 1987: 687, fig. 6, pl. 2 D-E.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: st. CP 1110, 14°49.16'S, 167°15.18'E, 1360 m, 08.10.1994: 1 ♂ 7.8 x 7.1 mm (MNHN-B 27510). — St. CP 956, 20°33.41'S, 169°35.95'E, 1175-1210 m, 20.09.1994: 1 ♂ 7.3 x 7.1 mm (MNHN-B 27511).

DISTRIBUTION. — Madagascar (N.W. coast) and now Vanuatu.

Ethusina microspina sp. nov.

Figs 1-2, 5

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: st. CP 992, 18°52.34'S, 168°55.16'E, 775-748 m, 24.09.1994: ♂ holotype 6.0 x 6.2 mm (MNHN-B 27512). — St. CC 996, 18°52.41'S, 168°55.73'E, 764-786 m, 24.09.1994: 2 ♀ paratypes 9.0 x 9.2 mm, 8.9 x 9.0 mm ovig. (MNHN-B 27513). — St. CP 1074, 15°48.42'S, 167°24.27'E, 775-798 m, 04.10.1994: 1 ♂ paratype 6.1 x 6.2 mm (MNHN-B 27514).

Carapace slightly broader than long, anterior narrow, posterior broad, female carapace more swollen than male. Dorsal surface covered with short pubescence, mesogastric and branchial regions slightly convex. Middle line of cardiac region depressed, its lateral sides convex. Cervical, branchial and branchiocardiac grooves broad and shallow in male, thin in female. Front divided into 4 teeth by one V-shaped and two U-shaped notches: median teeth and lateral teeth short spine-shaped; outer border of lateral teeth to exorbital spine obliquely straight. Exorbital tooth minutely spined, part of eyestalk visible from dorsal view, more distinct in female than in male. Anterolateral border slightly sinuous, with a small incision located between anterolateral and posterolateral borders. Anterior half of posterolateral borders outwardly swollen, posterior half inwardly convergent. Median part of posterior border concave.

Male right cheliped slightly larger than left. Merus triprismatic. Larger palm swollen, 1.32 times as long as high ; smaller palm 1.46 times as long as high. Fingers longer than palm, cutting edges with blunt teeth. Female chelipeds symmetrical.

Second pair of pereiopods longest, merus 7 times as long as high. Carpus shorter than propodus. Dactylus longer than propodus. Last two legs slender and short, with sparsely distributed short setae. Merus of last leg 6 times as long as high.

Male abdomen consists of five segments (3rd-5th fused): first segment 3.5 times as broad as long; second segment 8 times as broad as long; distal half of lateral border of fused section (segments 3rd-5th) inwardly convergent, its basal half swollen; sixth segment square, median line of its anterior border concave, anterior outer border of each side bluntly rounded; telson semi-rounded. Female abdomen divided into seven segments: length of segments 1-5 about equal; segments 1-3 gradually broadening; segments 4-6 to telson gradually convergent; sixth segment trapezoid, and telson broadly triangular.

Male first pleopods stout, proximal part stouter than distal part, with 2 blunt processes near distal part. Second male pleopods slender, not thin, distal half narrower than proximal half.

REMARKS. — This new species is similar to *Ethusina brevidentata* Chen, 1993 but it may be distinguished from the latter by its carapace being broader than long, by having short pubescence, lacking sharp granules; only part of eyestalk visible from dorsal view; minutely spined exorbital tooth; asymmetrical male chelipeds; semi-rounded telson of male abdomen; male first pleopods with two processes near distal part and slightly stouter second pleopods.

Source : MNHN, Paris

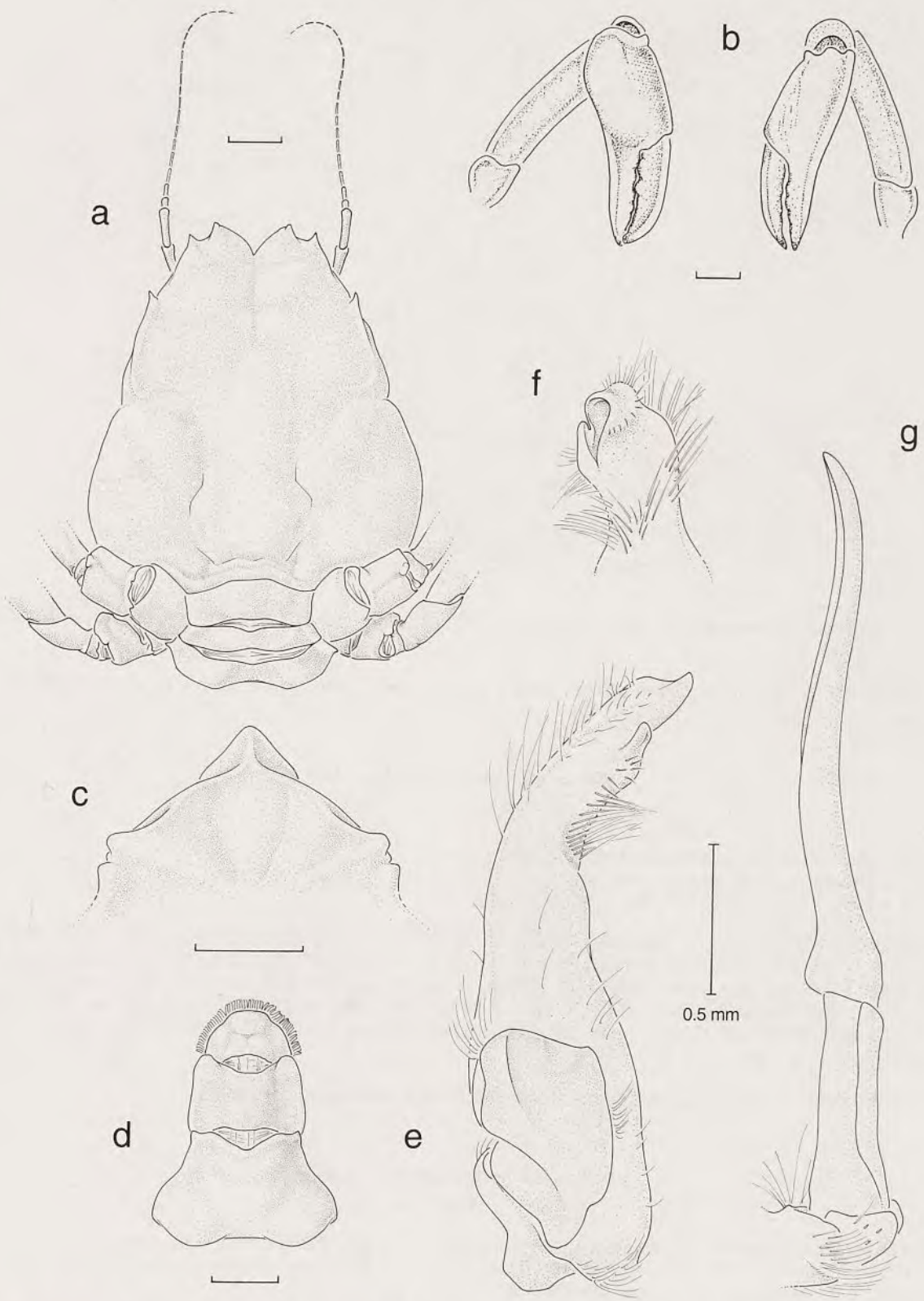

FIG. 1. — *Ethusina microspina* sp. nov.: holotype ♂ 6.0 x 6.2 mm (MNHN-B 27512): **a**, carapace; **b**, chelipeds (ventral view); **c**, anterior sternal shield; **d**, abdomen; **e-f**, first pleopod; **g**, second pleopod. Scales = 1 mm.

Source : MNHN, Paris

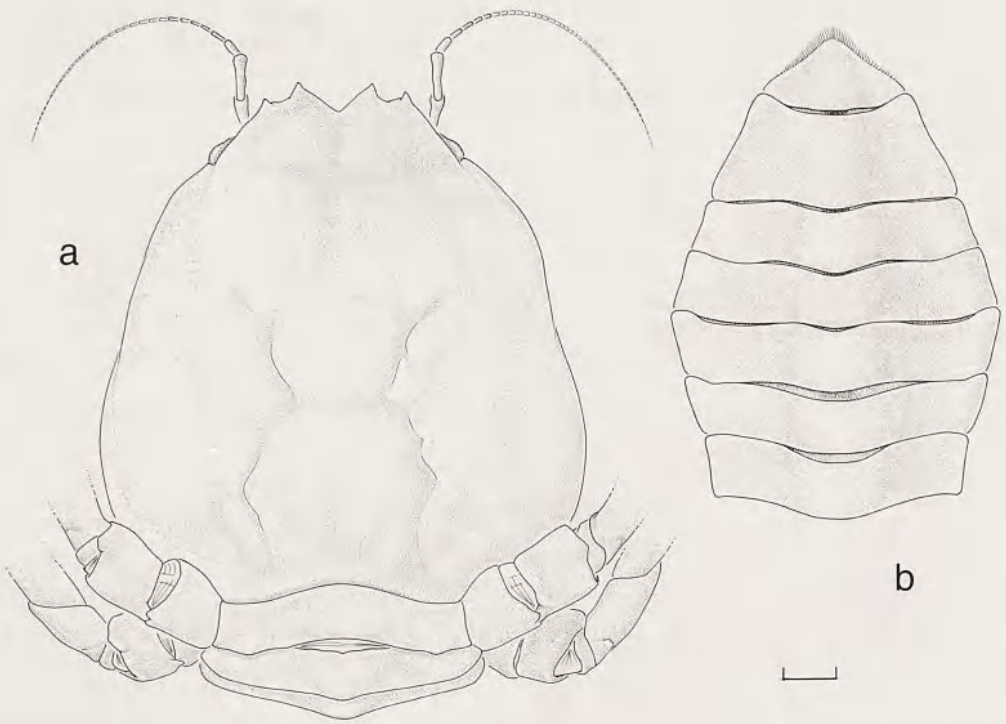

FIG. 2. — *Ethusina microspina* sp. nov.: paratype ♀ 9.0 x 9.2 mm (MNHN-B 27513): **a**, carapace; **b**, abdomen. Scale = 1 mm.

ETYMOLOGY. — From the Greek *mikros*, small, and the Latin *spina*, spine, in reference to the shape of the exorbital tooth.

Ethusina robusta Miers, 1886

Fig. 3

Ethusina (Ethusina) var. *robusta* Miers, 1886: 333, pl. 29 figs 2a-c.
Ethusina gracilipes robusta - SERÈNE, 1968: 40.
Ethusina robusta - Chen, 1986: 133, fig. 13(62-66); 1993: 342.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: st. DW 1128, 16°02.14'S, 166°38.39'E, 778-811 m, 10.10.1994: 1 ♀ 8.0 x 8.0 mm (MNHN-B 27515). — St. CP 1037, 18°03.70'S, 168°54.40'E, 1058-1086 m, 29.09.1994: 1 ♂ 11.5 x 11.0 mm (MNHN-B 27516). — St. 1125, 15°57.63'S, 166°38.43'E, 1160-1120 m, 10.10. 1994: 1 ♀ 8.1 x 8.2 mm (MNHN–B 27517). — St. CP 1111, 14°51.09'S, 167°14.00'E, 1210-1250 m, 08.10.1994: 1 ♀ 12.3 x 12.5 mm (MNHN-B 27518). — St. CP 1026, 17°50.35'S, 168 39.33'E, 437-504 m, 28.09.1994: 1 ♀ 7.9 x 7.9 mm (MNHN-B 27519).

DISTRIBUTION. — China, the Philippines, Indonesia, New Caledonia and Vanuatu.

Ethusina vanuatuensis sp. nov.

Fig. 4

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: st. CP 1026, 17°50.35'S, 168°39.33'E, 437-504 m, 28.09.1994: ♂ holotype 6.0 x 5.6 mm (MNHN-B 27520). — St. CP 1129, 16°00.73'S, 166°39.94'E, 1014-1050 m, 10.10.1994: 1 ♂ paratype 5.9 x 5.7 mm (MNHN-B 27521).

Carapace slightly longer than broad, covered with short pubescence. Cervical groove narrow, branchial groove broad and shallow. Protogastric, mesogastric, metagastric and branchial regions slightly convex. Cardiac region

Source : MNHN, Paris

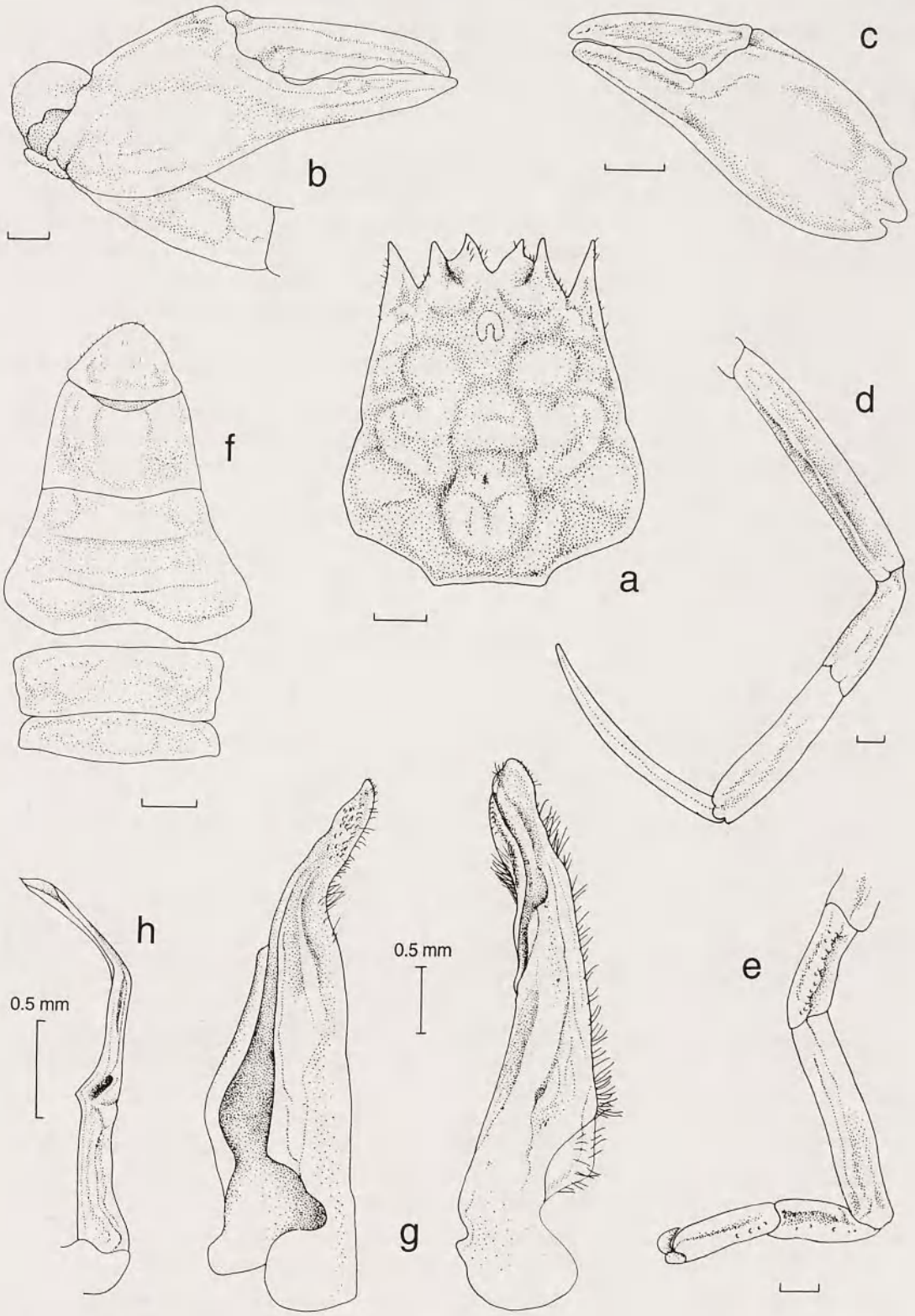

FIG. 3. — *Ethusina robusta* Miers, 1886. ♂ 11.5 x 11.0 mm (MNHN-B 27516): **a**, carapace; **b**, right cheliped (ventral view); **c**, left chela (ventral view); **d**, right second leg; **e**, right last leg; **f**, abdomen; **g**, first pleopod; **h**, second pleopod. Scales = 1 mm.

Source : MNHN, Paris

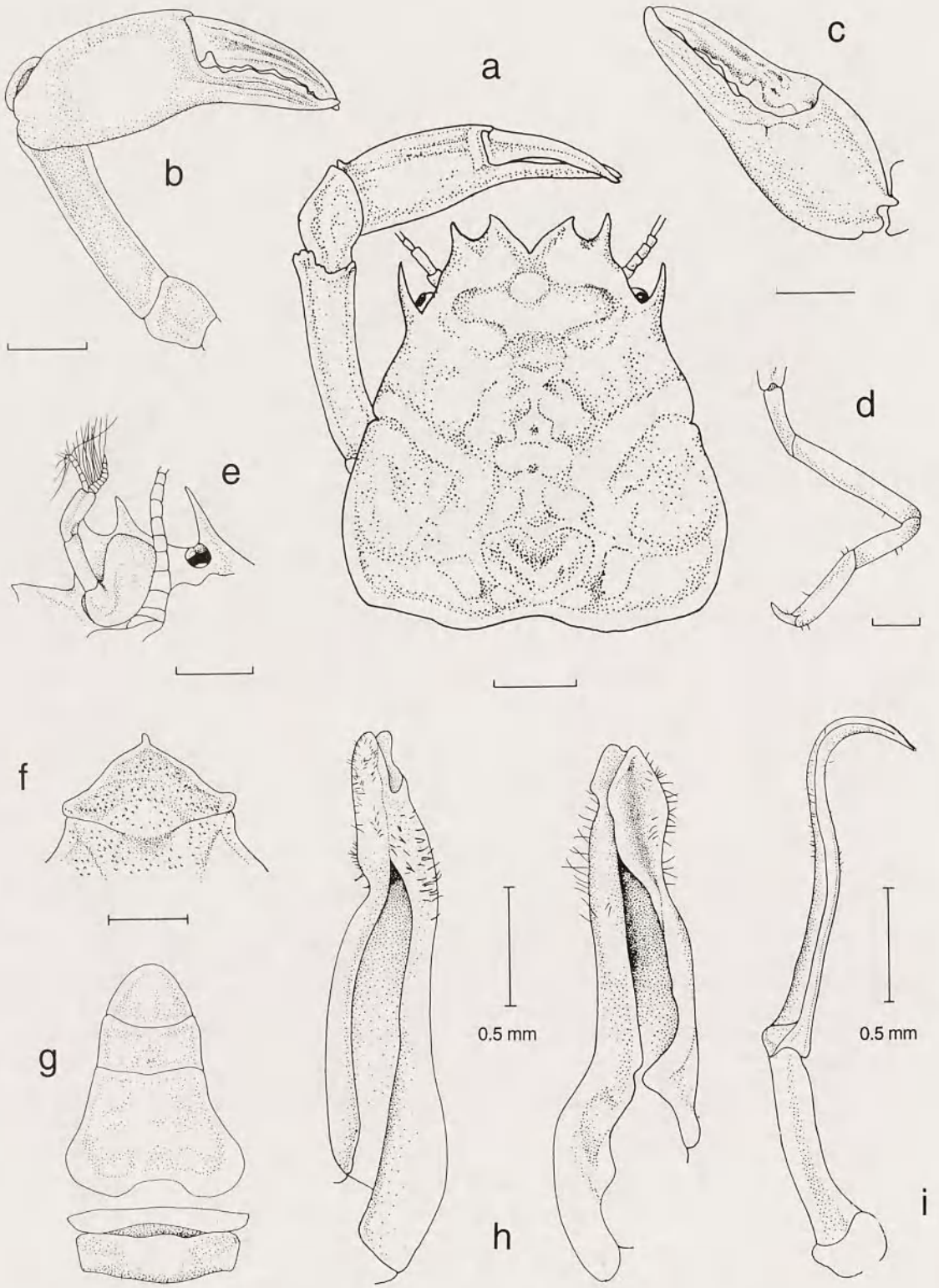

FIG. 4. — *Ethusina vanuatuensis* sp. nov.: holotype ♂ 6.0 x 5.6 mm (MNHN-B 27520): **a**, carapace and left cheliped; **b**, right cheliped (ventral view); **c**, left chela (ventral view); **d**, right fifth leg; **e**, anterior portion of carapace (ventral view); **f**, anterior sternal shield; **g**, abdomen; **h**, first pleopod; **i**, second pleopod. Scales = 1 mm.

Source : MNHN, Paris

cordiform, convex. Front with 4 teeth: median teeth short and sharp, lateral teeth long, blunt. Exorbital teeth long, sharp, and curved inwards. Posterior half of anterolateral borders and anterior half of posterolateral border gradually convex, posterior half of posterolateral border gradually convergent. Posterior border concave.

Male chelipeds equal in size and shape. Merus triprismatic, 4 times as long as high. Palm swollen. Finger longer than palm, movable finger with blunt teeth and a larger tooth and with a small gap near the base; immovable finger with blunt teeth.

Anterior two pairs of ambulatory legs smooth, second legs longest. Merus 8.5 times as long as high. Carpus as long as propodus. Dactylus longer than propodus; last two pairs of legs covered with short and dense pubescence. Merus of last leg 6 times as long as high. Dactylus very short.

Male abdomen consists of five segments (3rd-5th fused): first segment 3 times as long as second; distal half of lateral border of fused section (segments 3rd-5th) inwardly convergent, its basal half swollen; 6th segment 2.2 times as broad as long; telson bluntly triangular.

Male first pleopods stout, distal third narrower than basal two-thirds, with sparsely distributed short setae, distal end with 2 lobes. Second pleopods relatively stouter, distal part hooked.

REMARKS. — This new species is similar to *Ethusina dilobotus* Chen, 1993, but may be easily distinguished from it by the 4 front teeth being slightly longer and the exorbital teeth being inwardly curved, by the anterior two pairs of pereiopods being much longer and by the different shape of the male first and second pleopods.

ETYMOLOGY. — This species is named after the locality, Vanuatu, where it has been found.

ACKNOWLEDGMENTS

This study has been supported by a visitors' grant from IRD (ex ORSTOM). The author is very grateful to A. CROSNIER, IRD and Muséum national d'Histoire naturelle, Paris, for providing the material for this study and reviewing the manuscript; to B. RICHER DE FORGES, IRD Nouméa, New Caledonia, for collecting most of the specimens studied here; to J.F. DEJOUANNET for the drawings of *Ethusa microspina*, to R. VON COSEL for the photos.

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Source : MNHN, Paris

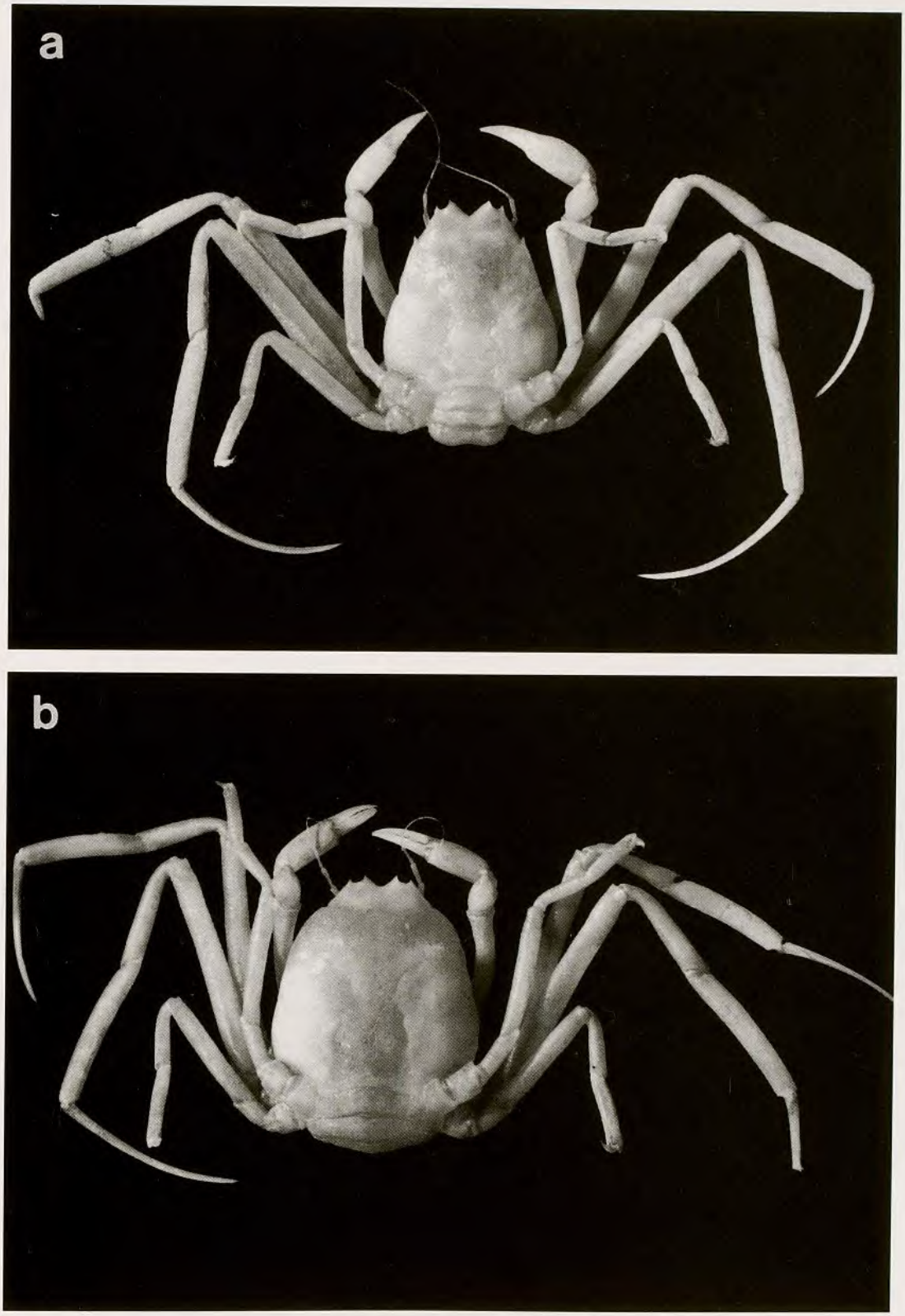

FIG. 5. — *Ethusina microspina* sp. nov.: **a**, holotype ♂ (MNHN-B 27512); **b**, paratype ♀ (MNHN-B 27513).

Source : MNHN, Paris

Source : MNHN, Paris

10

Crustacea Decapoda: A revision of the Indo-west Pacific species of palicid crabs (Brachyura Palicidae)

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ABSTRACT

The taxonomy of the crabs belonging to the family Palicidae Bouvier, 1898 from the Indo-west Pacific region is revised. On the basis of extensive material collected by French expeditions in the Coral Sea and other regions of the Pacific and Indian oceans, as well as material from numerous museums, including most of the types, the present study recognizes two subfamilies, 10 genera, and 43 species. Of these taxa, four are new genera: *Exopalicus*, *Miropalicus*, *Paliculus*, and *Rectopalicus*. *Manella* is synonymized with *Crossotonotus* A. Milne Edwards, 1873. *Parapleurophricoides* Nobili, 1906, sometimes believed to be a palicid, is a xanthoid and it is removed from the Palicidae. Nine nominal species described by previous authors are synonymized and an additional 17 species are described.

RÉSUMÉ

Crustacea Decapoda : Révision des espèces indo-ouest pacifiques de crabes palicides (Brachyura Palicidae).

La taxonomie des crabes de la famille Palicidae Bouvier, 1898, provenant de l'Indo-ouest Pacifique est révisée. Basée sur l'abondant matériel récolté par les expéditions françaises en mer de Corail et dans d'autres régions des océans Pacifique et Indien, ainsi que sur du matériel provenant de nombreux muséums renfermant la plupart des types, la présente étude reconnaît deux sous-familles, dix genres et 43 espèces. Parmi ces taxa, quatre sont des genres nouveaux : *Exopalicus*, *Miropalicus*, *Paliculus*, et *Rectopalicus*. Le genre *Manella* est mis en synonymie avec *Crossotonotus* A. Milne Edwards, 1873. *Parapleurophricoides* Nobili, 1906, parfois considéré comme étant un palicide, est un xanthide et est retiré de la famille Palicidae. Neuf espèces décrites antérieurement sont mises en synonymie, tandis que 17 autres sont décrites comme nouvelles.

CASTRO, P., 2000. — Crustacea Decapoda : A revision of the Indo-west Pacific species of palicid crabs (Brachyura Palicidae). *In*: A. CROSNIER (ed.), Résultats des campagnes MUSORSTOM, Volume 21. *Mémoires du Muséum national d'Histoire naturelle*, **184**: 437-610. Paris ISBN: 2-85653-526-7.

Source : MNHN, Paris

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Source : MNHN, Paris

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INTRODUCTION

Brachyuran crabs belonging the family Palicidae Bouvier, 1898 are a group rather neglected by taxonomists and ecologists alike, notwithstanding their sometimes frequent occurrence in several marine environments. The feeding habits, locomotion, reproduction, and larval development of palicids remain practically unknown. The evolution and biological significance of the reduced last pair of pereopods of most species remain vexing questions. The taxonomy of the family and its position within the Brachyura have also remained much neglected subjects.

The family Palicidae consisted of four ill-defined genera until the revision of the Indo-west Pacific species by MOOSA & SERÈNE (1981): *Palicus* Philippi, 1838, *Crossotonotus* A. Milne Edwards, 1873, *Pleurophricus* A. Milne Edwards, 1873, and *Manella* Rathbun, 1906. A fifth genus, *Parapleurophrycoides* Nobili, 1906 was questionably included in the family by SERÈNE (1968, as *Pleurophrycoides* [*sic*]). Most species were grouped into one genus, *Palicus*, with RATHBUN (1918) recognizing 21 western Atlantic and eastern Pacific species in six "groups". Three more species from this area (all in *Palicus*) were subsequently described. An additional species, *P. caronii* (Roux, 1830), is Mediterranean and eastern Atlantic in distribution. In the Indo-west Pacific, 24 species (16 in *Palicus*) had been described until 1981 (SERÈNE, 1968; ZARENKOV, 1968). While describing two new western Pacific species, ZARENKOV (1968: 765) briefly commented on RATHBUN's groups of *Palicus* species without revising her classification.

Source : MNHN, Paris

The first and until now the only major revision of Indo-west Pacific palicids was that of MOOSA & SERÈNE (1981). They separated the family into two subfamilies, Palicinae *s. str.* and Crossotonotinae Moosa & Serène, 1981. For the Palicinae, MOOSA & SERÈNE (1981) restricted *Palicus* for the Atlantic, Mediterranean, and eastern Pacific species, and established four new genera (*Neopalicus*, *Palicoides*, *Parapalicus*, and *Pseudopalicus*) for the 26 species they recognized from the Indo-west Pacific. Six new species were described from these genera. Within the subfamily Crossotonotinae, MOOSA & SERÈNE (1981) initially recognized four genera, *Crossotonotus*, *Parapleurophrycoides*, *Pleurophricus*, and *Manella*, with a total of six species. *Parapleurophrycoides* and its only species, however, were "discarded" since the description of the species was based on a juvenile "which cannot be used for the definition of the genus" (MOOSA & SERÈNE, 1981: 52).

Unfortunately, the revision of MOOSA & SERÈNE (1981) was based on limited material. They examined specimens belonging to only nine of the 24 Indo-west Pacific species known at the time and the type material of only one of the nine species. In addition, the identities of several species (such as *Parapleurophrycoides roseus* Nobili, 1906) were left unresolved.

Three Indo-west Pacific species of palicids were described after MOOSA & SERÈNE's revision: *Palicus trituberculatus* Chen, 1981 (its description was apparently published before the revision), *Palicus bidentatus* Sakai, 1983, and *Parapalicus nanshaensis* Dai & Xu, 1991, bringing the total number of nominal species known from the region to 33. About 58% of all the known species of palicids (34 out of 58) are Indo-west Pacific in distribution.

The study of a large collection of palicids from numerous French expeditions (mostly from the Coral Sea but also from several other areas of the Indo-west Pacific region) plus type material and other specimens from museums, institutions, and private collections from around the world provided the opportunity to undertake a more comprehensive revision of the Indo-west Pacific Palicidae.

PRESENTATION AND TERMINOLOGY

A list of complete references is given for each of the species treated, while references for the family are restricted to those where characters or the status of the family are discussed. All geographic names in English follow, whenever possible, the orthography given in the ninth revised edition (1993) of the *Times Atlas* (Times Books, London).

The measurements given in the text, unless specified, refer to carapace length (CL) and carapace width (CW). The length of the carapace was measured across the middle of the carapace from the tip of the longest lobe of the frontal border to the posterior border, including any tubercles along the posterior border. The width of the carapace was measured across the widest breadth, including the longest anterolateral tooth on each side.

The total length of the walking legs (P2-4) was measured along each segment from the proximal edge of the merus to the tip of the dactylus. The fifth pair of pereopods were measured from the proximal edge of the basis-ischium to the tip of the dactylus. The abdomen was treated as consisting of six segments and a telson.

The terminology used to refer to parts of the dorsal surface of the carapace and pereopods is summarized in Fig. 1, while that used to refer to the anterior and ventral surfaces of the carapace, male and female abdomens, and male first pleopods is summarized in Fig. 2.

The depth range reported for each species gives the minimum and maximum depths at which each species was collected with accuracy. Extreme depth values are also given for some species since dredgings depths in some of the stations varied widely and it was impossible to know the exact depths of collection.

The following abbreviations are used to refer to the deposit of the examined material.

AM. — Australian Museum, Sydney, Australia.
ASIO. — Institute of Oceanology, Academia Sinica, Qingdao, China.
ASIZB. — Academia Sinica, Beijing, China.
ASIZT. — Institute of Zoology, Academia Sinica, Taipei, Taiwan.
BMNH. — The Natural History Museum [formerly British Museum (Natural History)], London, U.K.
BPBM. — Bishop Museum, Honolulu, Hawaii, U.S.A.

Source : MNHN, Paris

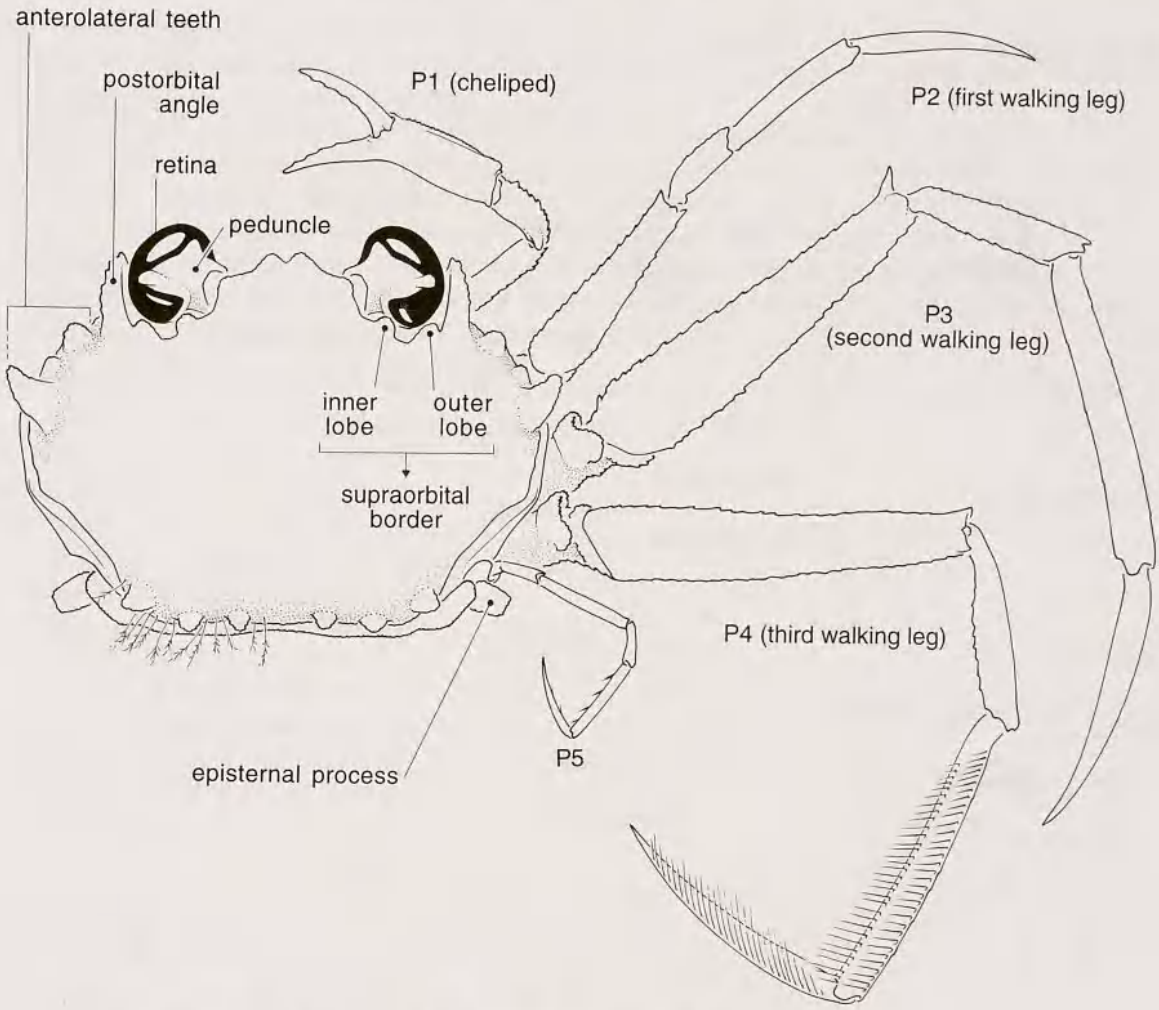
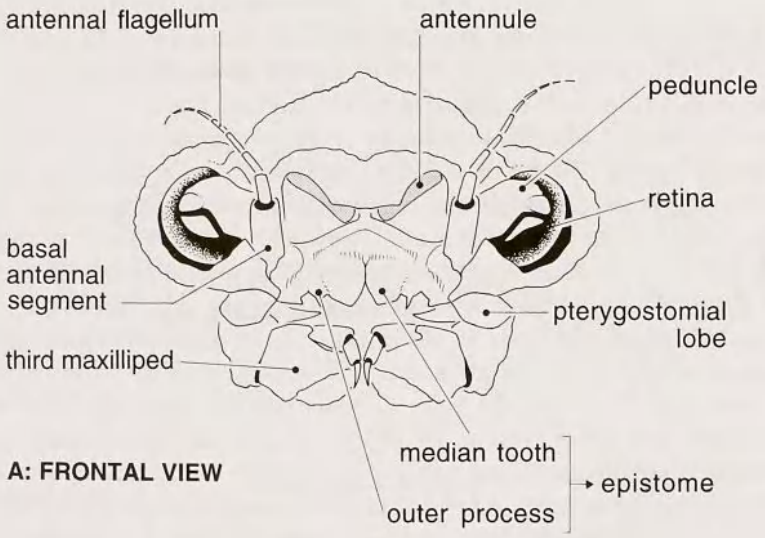


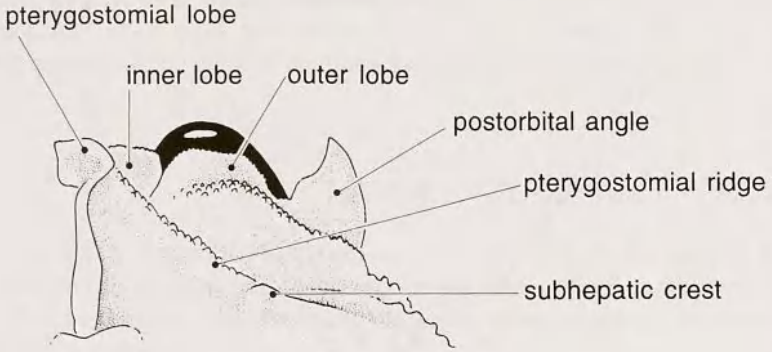
FIG. 1. — Terminology used to describe the carapace and the pereopods.

CBM. — Natural History Museum and Institute, Chiba, Japan.
HSM. — Hayama Shiosai Museum, Hayama, Japan.
KMNH. — Kitakyushu Museum of Natural History, Kitakyushu, Japan.
KPM. — Kanagawa Prefectural Museum of Natural History, Odawara, Japan.
LACM. — Natural History Museum of Los Angeles County, Los Angeles, California, U.S.A.
MCZ. — Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, U.S.A.
MNHN. — Muséum national d'Histoire naturelle, Paris, France.
MZUF. — Museo di Zoologia "La Specola", Università di Firenze, Italy.
NTOU. — National Taiwan Ocean University, Keelung, Taiwan.
PMBC. — Phuket Marine Biological Center, Phuket, Thailand.
QM. — Queensland Museum, Brisbane, Australia.
RDC. — Research & Development Center for Oceanography, Jakarta, Indonesia.
RMNH. — Nationaal Natuurhistorisch Museum (formerly Rijksmuseum van Natuurlijke Historie), Leiden, The Netherlands.
SAM. — South African Museum, Cape Town, South Africa.
SMF. — Forschungsinstitut Senckenberg, Frankfurt am Main, Germany.
UMZ. — University Museum of Zoology, University of Cambridge, Cambridge, United Kingdom.
USNM. — United States National Museum, Smithsonian Institution, Washington, D.C., U.S.A.

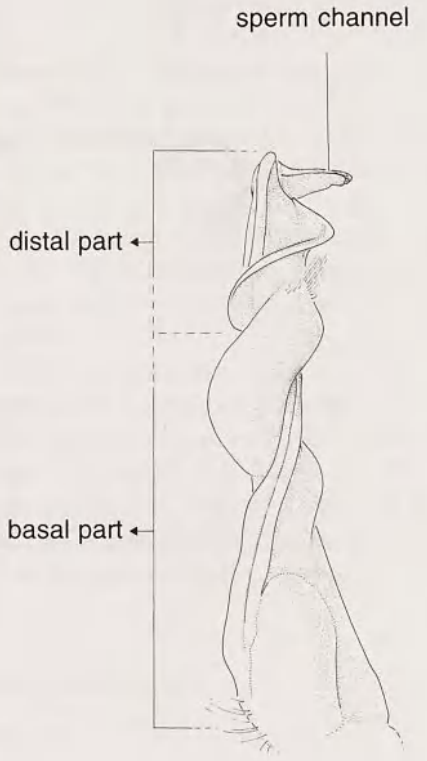
Source : MNHN, Paris



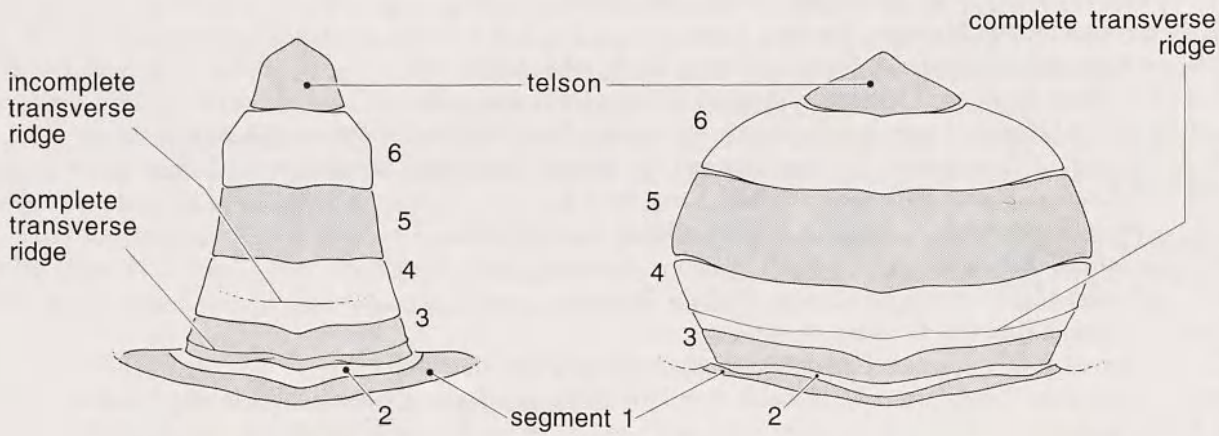
A: FRONTAL VIEW



B: SUBORBITAL BORDER



E: MALE FIRST PLEOPOD



C: MALE ABDOMEN

D: FEMALE ABDOMEN

FIG. 2. — Terminology used to describe: **A**, anterior end of the carapace; **B**, suborbital border of the carapace in *Pseudopalicus* and most other genera of palicids; **C**, male abdomen; **D**, female abdomen; **E**, male first pleopod.

Source : MNHN, Paris

WAM. — Western Australian Museum, Perth, Australia.
ZLKU. — Zoological Laboratory, Kyushu University, Fukuoka, Japan (now at Kitakyushu Museum of Natural History, Kitakyushu, Japan).
ZMA. — Zöologisch Museum, Universiteit van Amsterdam, The Netherlands.
ZMB. — Museum für Naturkunde (Zoologisches Museum), Universität Humboldt, Berlin, Germany.
ZMMU. — Zoological Museum, Moskow State University.
ZMUC. — Zoologisk Museum, Københavns Universitet, Copenhagen, Denmark.
ZMUH. — Zoologisches Institut und Zoologisches Museum, Universität Hamburg, Germany.
ZRC. — Zoological Reference Collection, Raffles Museum, Department of Biological Sciences, National University of Singapore, Singapore.

The expedition stations from which material was examined were described in the following publications:

BATHUS 1 to BATHUS 4: RICHER DE FORGES & CHEVILLON, 1996.
BERYX 11: LEHODEY *et al.*, 1992.
BIOCAL: RICHER DE FORGES, 1990.
BORDAU 1: RICHER DE FORGES *et al.*, 2000b
CHALCAL 1: RICHER DE FORGES, 1991.
CHALCAL 2: RICHER DE FORGES, 1990.
CORAIL 2: RICHER DE FORGES, 1991.
CORINDON: MOOSA, 1984.
Expédition MONTROUZIER: BOUCHET, 1994.
HALICAL 1: GRANDPERRIN *et al.*, 1995.
HALIPRO 1: RICHER DE FORGES & CHEVILLON, 1996.
KARUBAR: CROSNIER *et al.*, 1997.
LAGON: RICHER DE FORGES, 1991.
MUSORSTOM 1: FOREST, 1981.
MUSORSTOM 2: FOREST, 1985.
MUSORSTOM 3: FOREST, 1989.
MUSORSTOM 4 to MUSORSTOM 6: RICHER DE FORGES, 1990.
MUSORSTOM 5: RICHER DE FORGES *et al.*, 1986.
MUSORSTOM 7: RICHER DE FORGES & MENOU, 1993.
MUSORSTOM 8: RICHER DE FORGES *et al.*, 1996.
MUSORSTOM 9: RICHER DE FORGES *et al.*, 1996.
MUSORSTOM 10: RICHER DE FORGES *et al.*, 2000a
REVES 2: MARCHAL *et al.*, 1981.
SMIB 3, 4: RICHER DE FORGES, 1990.
SMIB 5, 6: RICHER DE FORGES, 1991; 1993.
SMIB 8: RICHER DE FORGES & CHEVILLON, 1996.
"Vauban" dredgings: RICHER DE FORGES, 1990.
VOLSMAR: LABOUTE *et al.*, 1989.

There is no available report on the LITHIST cruise carried out by R.V. *"Alis"* on the Norfolk Ridge Seamounts (4-8 August 1999).

SYSTEMATIC ACCOUNT

Family PALICIDAE Bouvier, 1898

Cymopoliidae Faxon, 1895: 38. — RATHBUN, 1918: 182. — SAKAI, 1939: 607. — BOUVIER, 1940: 303. — MONOD, 1956: 387. — BALSS, 1957: 1661.

Source : MNHN, Paris

Palicés Bouvier, 1897: 785 [vernacular].
Palici Bouvier, 1898a: 105.
Palicidae - RATHBUN, 1898: 600. — ALCOCK, 1900: 285, 450. — ZARENKOV, 1968: 762, 765. — TAKEDA & SHIMAZAKI, 1974: 75. — GUINOT, 1978: 249; 1979: 111. — MOOSA & SERÈNE, 1981: 22. — WILLIAMS, 1984: 481.
Palicae Bouvier, 1898b: 56, 58.

TYPE GENUS. — *Palicus* Philippi, 1838.

DIAGNOSIS. — Dorsal surface of carapace typically depressed, granular, often with high bosses of varying sizes; confluence of branchial and mesogastric regions depressed. Frontal border of carapace divided into 2-4 lobes. Anterolateral borders each with a varying number (1-4) of triangular, rounded, or truncate teeth. Supraorbital and suborbital borders long, usually with lobes (may be dentiform); orbits deep, wide. Antennae with basal segment rectangular or variously expanded; flagellum well developed. Retina of eyes dorsoventrally flattened or spherical; peduncles typically long, with soft or granular tubercles. Chelipeds small to moderate in size, equal or unequal (particularly in males). Antennules long, transversely folded beneath front; interantennular septum narrow. Epistome ventrally inclined (sunken) or dorsoventrally expanded. Buccal cavity square, mostly but not completely covered by third maxillipeds. Meri of third maxillipeds small, with palp on each inner border. Fifth pair of pereopods (P5) characteristically reduced in size (less than CL in practically all species), conspicuously more slender or of same morphology as anterior walking legs (P2-4). Male opening sternal; sperm ducts under sternal plates, penis soft, curved, free on inner side of coxae. Male first pleopods with helicoidal or sinuous basal parts, distal parts uniramous or biramous. Male and female abdomens with six segments plus telson, some (segments 1-2) can be dorsoventrally compressed, others fused. Male abdomen narrower than sternum, with both sides parallel to each other or triangular; locking mechanism with very low to medium-size tubercle at edge of thoracic sternite 5 and shallow concavity on underside (ventral surface) of abdominal segment 6. Abdomen of mature females rounded, broad, thoracic sternite 8 visible laterally; triangular in immature females. Vulva large, visible on thoracic sternite 5 but actually in sternite 6.

SUBFAMILIES INCLUDED. — Palicinae Bouvier, 1898; Crossotonotinae Moosa & Serène, 1981.

DISCUSSION. — The use of the name Palicidae (with *Palicus* Philippi, 1838 as the type genus) for the family instead of Cymopoliidae (with *Cymopolia* Roux, 1830 as the type genus) is by now accepted. The name *Cymopolia* is preoccupied by an alga, *Cymopolia* Lamouroux, 1816 (see HOLTHUIS & GOTTLIEB, 1958: 104). The use of *Cymopolia* and Cymopolidae has been rejected and the name "Palicidae Rathbun" placed in the official list of valid names (*Bulletin of Zoological Nomenclature*, 1964, 21: 336-351; 338, 341, 342, 344).

The correct authorship of the name Palicidae is a complicated question that fortunately has been clarified by L.B. HOLTHUIS (*in litt.*). RATHBUN (1898: 600) is generally credited as first using the family name Palicidae. It is the author of the family name Palicidae that is placed in the official list of valid names in zoology (see above). BOUVIER (1897: 785) for the first time used the term "Palicés" for a group based on the name of the genus *Palicus* but the name is not valid since it is a vernacular name (International Code of Nomenclature, fourth edition, 1999, article 11.3). An English translation (BOUVIER, 1898a) of BOUVIER's 1897 paper uses "palicids" as a translation of "Palicés" and as a vernacular name it is also invalid. A footnote on the same paper (BOUVIER, 1898a: 105) that is absent in the original paper in French states that the subfamily Dorippinae was to be subdivided into two tribes: "Palici (*Palicus*) and Dorippi (*Ethusa*, *Ethusina*, *Dorripe*)". The name "Palici" is an available name for the family since it was used for a suprageneric taxon and it was written in Latin. The name "Palicae" was also used by BOUVIER (1898b: 56, 58), which was published in the same year. Since its exact publication date could not be determined, 31 December 1898 is adopted as the publication date (International Code of Nomenclature, fourth edition, 1999, article 21.3.2). Palicidae BOUVIER, 1898 (a correction of "Palici"), which was published in January 1898 (BOUVIER, 1898a), thus has priority over Palicidae RATHBUN, 1898, which was published in June 1898.

The systematic position of the family Palicidae within the Brachyura remains uncertain. The placement of the family in relation to other families has varied from author to author (see MOOSA & SERÈNE, 1981: 22; WILLIAMS, 1984: 481). Before the establishment of the family, some of the species now included in the

Source : MNHN, Paris

subfamily Crossotonotinae were initially placed in various groups of the Brachyura (see discussion of the subfamily below).

Most evidence places the family close to the family Dorippidae (superfamily Dorippoidea of Heterotremata following GUINOT, 1977). There are similarities in the functional morphology of the male and female reproductive systems (GUINOT, 1979: 112, 113; 1978: 250) and in the circulation of respiratory water (MOOSA & SERÈNE, 1981: 23) as well as in what little is known about the morphology of the larvae (GURNEY, 1942: 275). The investigation of larval development and DNA analyses should provide some fresh evidence to support this or other alternate hypotheses.

The family was divided into two subfamilies by MOOSA & SERÈNE (1981: 23). Although radically different in the shape of their walking legs, *Crossotonotus* and the allied *Pleurophricus*, which are grouped together as the subfamily Crossotonotinae, share many characters with the remaining palicids so their inclusion in the family Palicidae is not in doubt.

Key to the subfamilies of the family Palicidae

1. Fifth pair of pereopods (P5) conspicuously reduced, shorter, more slender than anterior walking legs (P2-4), with articulation to carapace dorsal to those of P2-4. Segments 1-2 of male and female abdomens dorsoventrally compressed and very narrow in comparison to remaining four segments of abdomen ..... PALICINAE Bouvier, 1898

— Fifth pair of pereopods (P5) shorter but similar in shape to anterior walking legs (P2-4), with articulation to carapace at same level as those of P2-4. Segments 1-2 of male and female abdomens wide, not dorsoventrally compressed .... CROSSOTONOTINAE Moosa & Serène, 1981

Subfamily PALICINAE Bouvier, 1898

Palicinae Moosa & Serène, 1981: 23.

TYPE GENUS. — *Palicus* Philippi, 1838

DIAGNOSIS. — Fifth pair of pereopods (P5) reduced in size to less than length of carapace, different in shape to anterior walking legs (P2-4); articulation to carapace dorsal to walking legs. Carapace with very conspicuous teeth or pointed tubercles only along anterolateral border. Dorsal surface of carapace typically convex. Episternal process of thoracic sternite 7, sometimes reduced, overhanging each posterolateral border of carapace posterior to fifth pair of pereopods. Epistome dorsoventrally broadened. Abdomen of males and females with segments 1-2 dorsoventrally compressed, some segments may be fused, complete or incomplete, transverse ridges (carinae) may be present.

GENERA INCLUDED. — Nine genera are included, by alphabetical order: *Exopalicus* new genus, *Miropalicus* new genus, *Neopalicus* Moosa & Serène, 1981, *Palicoides* Moosa & Serène, 1981, *Paliculus* new genus, *Palicus* Philippi, 1838, *Parapalicus* Moosa & Serène, 1981, *Pseudopalicus* Moosa & Serène, 1981, *Rectopalicus* new genus.

DISCUSSION. — The subfamily was recognized by MOOSA & SERÈNE, 1981 as a group for all palicids with a reduced and slender fifth pair of pereopods. The subfamily includes all Atlantic, Mediterranean, and eastern Pacific species (all of which make up *Palicus*) as well as eight genera that are restricted to the Indo-west Pacific region. *Palicus* [with *Palicus granulatus* Philippi, 1838, a junior subjective synonym of *Cymopolia caronii* Roux, 1830, as its type species by monotypy] needs to be revised. As it now stands, it is undoubtedly heterogeneous, a suggestion indirectly made by RATHBUN (1918: 184) with her grouping of 21 American species into six different groups.

Source : MNHN, Paris

TABLE 1. — Morphological differences between *Palicus* Philippi, 1838 (as exemplified by *P. caroni* Roux, 1830), *Parapalicus* Moosa & Serène, 1981, *Pseudopalicus* Moosa & Serène, 1981, *Parapalicus* Moosa & Serène, 1981, *Miropalicus* new genus, *Paliculus* new genus, *Rectopalicus* new genus, *Rectopalicus* new genus, *Neopalicus* Moosa & Serène, 1981, and *Palicoides* Moosa & Serène, 1981.

	Palicus Philippi, 1838 (*P. caroni* Roux 1830)	***Pseudopalicus*** Moosa & Serène, 1981	***Parapalicus*** Moosa & Serène, 1981	***Miropalicus*** new genus
Carapace	Subquadrate; granular; four lobes on anterior border	Transversely hexagonal; conspicuous granular bosses; four lobes on anterior border	Transvarseley subovate; granules and mostly shallow bosses; two small lobes (can be secondarilly notched) on anterior border	Transversely subovate; granules and shallow bosses; two small lobes on anterior border
Antennae	Basal antennal segment not expanded; flagellum with setae	Basal antennal segment slender or slightly expanded; flagellum with many conspicuous setae	Basal antennal segment slightly expanded (scale-like); flagellum with setae	Basal antennal segment slender, not expanded; flagellum with setae
Eyes	Cornea spherical, wider than peduncle; conspicuous tubercles on peduncle	Cornea dorso-ventrally flattened or spherical, wider or as wide as peduncle	Cornea dorsoventrally flattened, wider than peduncle	Cornea dorso-ventrally flattened, much wider than peduncule
Supraorbital borders	Two large triangular lobes	Two lobes	1-2 notches	Two shallow, round lobes
Suborbital borders	Two wide, shallow lobes	Two lobes	Typically two teeth-like lobes	Inner lobe limited by large pterygostomial lobe; one shallow, round outer lobe
Anterolateral borders	2-3 large, flat teeth	3-4 typically pointed teeth	One triangular or round tooth	Three round teeth
Epistome	Narrow	Narrow	Dorsoventrally expanded	Narrow
Chelipeds	Large and heavily tuberculated in males; one slender and one larger in females	Heavy, unequal and tuberculated in males; more slender and more equal in females	Very slender, elongate and equal in males and females; small tubercles, teeth, or smooth surface	Large, unequal in males and females; heavy tubercles
Pereopod 2 (leg 1)	Only slightly shorter than P3-4; flattened	More slender and shorter than P3-4; flattened	More slender and shorter than legs P3-4; filiform	More slender and shorter than P3, only sligthly longer than P4; filiform
Pereopod 3 (leg 2)	Long, flattened; meri with unequal tubercles outer border of dactylus entire	Long, flattened; meri with unequal tubercles; posterior border of dactylus entire or with teeth	Very long, slender and filiform; meri with equal tubercles; posterior border of dactylus entire	Very long, slender and filiform; meri with equal tubercles; proximal, posterior border of dactylus with short spines
Pereopod 5	Short, slender; granules on segments, thick spines on merus and propodus	Short, slender, small tubercles and spines; slightly thicker in some species	Short, very slender; granules and spines	Short, very slender; granules and spines
Mature male abdomen	Elongate, sides almost parallel; complete segments; ridge along each segment 1-4	Elongate, sides almost parallel; complete segments; ridge typically along each segment 2-3 but varies according to species	Triangular; segments 3-5 fused; tubercles on segment 3 and usually on 4	Elongate, sides almost parallel; complete segments; ridge along each segment 1-4
First male pleopod	Sinuous basal part	Sinuous basal part; mostly biramous but some uniramous distal part	Sinuous basal part; uniramous or sinuous tips	Straight basal part; uniramous distal part
Mature female abdomen	Complete segments; ridge along each segment 1-4	Complete segments; typically ridge along each segment 2-4 but varies according to species	Segments 3-5 fused; typically ridge along each segment 1-4	Complete segments; ridge along each segment 1-5

	Paliculus new genus	***Rectopalicus*** new genus	***Exopalicus*** new genus
Carapace	Subquadrate; tuberculate; two small lobes on anterior border	Subquadrate or subpyriform; 2-4 lobes on anterior border	Hexagonal; two lobes on anterior border
Antennae	Basal antennal segment slender or slightly expanded; flagellum with conspicuous setae	Basal antennal segment rectangular and thick; flagellum short with few setae	Basal antennal segment short, rectangular; flagellum short with few setae
Eyes	Cornea dorsoventrally flattened; conspicuous tubercles on peduncle	Cornea dorsoventrally flattened; granular tubercles on peduncle	Cornea dorsoventrally flattened; granular tubercles on very short peduncle
Supraorbital borders	One or two lobes	Two lobes	One shallow lobe

Source : MNHN, Paris

Suborbital borders	Inner lobe limited by large pterygostomial lobe; 1-2 outer lobes	Two lobes	Two lobes
Anterolateral borders	1-4 pointed teeth	Shallow, truncate teeth	Three broad and triangular teeth plus tubercles
Epistome	Narrow	Narrow or dorsoventrally expanded	Slightly expanded dorsoventrally
Chelipeds	Unequal in males and females; more slender in females	Unequal or nearly equal in males and females	Equal in males and females
Pereopod 2 (leg 1)	More slender and shorter than P3-4; filiform or flattened	More slender and shorter than P3-4; flattened	More slender and shorter than P3-4; flattened
Pereopod 3 (leg 2)	Very long, slender and filiform or shorter, flattened; merus with equal or unequal tubercles; posterior border of dactylus entire	Long, flattened; merus with nearly equal tubercles; posterior border of dactylus with spines	Long, flattened; merus with nearly equal tubercles; posterior border of dactylus with spines
Pereopod 5	Short, very slender; posterior border of dactylus with spines	Short, thick or slender; posterior border of dactylus with spines	Very short, thick; posterior border of dactylus with few spines
Mature male abdomen	Elongate, sides almost parallel; complete segments; ridge along each segment 1-4	Elongate, sides almost parallel; complete segments; ridge along each segment 1-3 or 1-4	Elongate, sides almost parallel, tuberculate; complete segments; ridge along each segment 1-5
First male pleopod	Straight basal part; biramous distal part	Sinuous basal part; uniramous or biramous distal part	Sinuous basal part; uniramous distal part
Mature female abdomen	Segments 3-5 or 4-6 fused; ridge along each segment 1-3	Segments complete; ridge along each segment 1-4	Segments complete; ridge along each segment 1-4

	Neopalicus Moosa & Serène, 1981	*Palicoides* Moosa & Serène, 1981
Carapace	Subquadrate; large granules in horizontal rows and shallow bosses; two lobes on anterior border, each followed by notch	Subquadrate; large granules and shallow bosses; two lobes on anterior border
Antennae	Basal antennal segment expanded as thick or V-shaped process; flagellum with very few setae	Basal antennal segment expanded as thick, scale-like process; segments 2-3 expanded and with many long setae; flagellum short with few setae
Eyes	Cornea spherical, almost as wide as peduncle; conspicuous (round, not crescent-shaped) tubercle on peduncle	Cornea spherical, almost as wide as peduncle; conspicuous crescent-shaped process on peduncle
Supraorbital borders	1-2 triangular lobes	1-2 triangular lobes
Suborbital borders	Two triangular lobes	Two lobes
Anterolateral borders	Two slightly salient, truncate teeth	Two trucate teeth
Epistome	Dorsoventrally expanded	Dorsoventrally expanded
Chelipeds	Long and slender, thicker in males; very small to large tubercles	Long and slender, nearly equal in males and females, heavier and longer in males; small tubercles
Pereopod 2 (leg 1)	More slender and shorter than P3-4; flattened	More slender and shorter than P3-4; flattened
Pereopod 3 (leg 2)	Long, flattened; merus with unequal tubercles; anterior border of propodus with convex expansion; posterior border of dactylus entire	Long, flattened; merus with unequal tubercles; posterior border of dactylus entire
Pereopod 5	Short, thick and granular; thick spines on posterior border of propodus	Short, thick and granular; thick spines on posterior border of propodus
Mature male abdomen	Elongate, sides almost parallel; complete segments; ridge along each segment	Elongate, sides almost parallel; fusion of segments varies according to age and species; ridge typically along each segment
First male pleopod	Sinuous basal part; biramous distal part	Sinous basal part; biramous distal part
Mature female abdomen	Complete segments; ridge along each segment	Segments 2-6 fused; ridge along each segments 1-2 and two along fused segment 3-6.

Source : MNHN, Paris

Key to the Indo-west Pacific genera of the subfamily Palicinae

1. Walking legs (P2-4) not slender, with flattened carpi and propodi; meri with unequal tubercles or teeth (rounded tubercles if equal or nearly equal) along upper and lower borders; dactyli may be armed with teeth or spines along complete length of posterior borders .. **2**
— Walking legs (P2-4) typically very slender, with elongate meri, filiform (long, very narrow) propodi and dactyli; meri with equal or nearly equal, small (or flat, rounded if not small) tubercles along upper and lower borders; dactyli without teeth or spines along complete length of posterior borders **6**

2. Carapace transversely hexagonal (clearly wider than long), with conspicuously curved anterolateral borders that are armed with triangular and pointed or rounded teeth **3**
— Carapace subquadrate (almost as wide as long), with straight or only slightly curved anterolateral borders that are armed with truncate teeth **4**

3. Dorsal border of carapace slightly convex. Eye peduncles long. Walking legs long to very long, P3 much longer than carapace length (1.5 CL or more) ..... ***PSEUDOPALICUS*** Moosa & Serène, 1981
— Dorsal border of carapace conspicuously convex, almost hemispherical in outline. Eye peduncles very short (Fig. 38a). Walking legs conspicuously short, P3 only slightly longer than carapace length (1.2 CL or less) ..... ***EXOPALICUS*** new genus

4. Supraorbital borders with rounded or rectangular lobes. Posterior borders of propodi and dactyli of walking legs (P2-4) with spines ..... ***RECTOPALICUS*** new genus
— Supraorbital borders with triangular, dentiform lobes. Posterior borders of propodi and dactyli of walking legs (P2-4) entire, without spines **5**

5. Eye peduncles with rounded, granular tubercles. Anterior borders of propodi of P3-4 with wide, convex enlargement ..... ***NEOPALICUS*** Moosa & Serène, 1981
— Eye penduncles with thin, calcified, crescent-shaped process on anterior border. Anterior borders of propodi of P3-4 without conspicuous enlargement ..... ***PALICOIDES*** Moosa & Serène, 1981

6. One triangular or rounded tooth on anterolateral side of carapace. Abdomen of males triangular. Basal antennal segment slightly expanded distally, forming scale-like structure ..... ***PARAPALICUS*** Moosa & Serène, 1981
— Two to four narrow, pointed teeth or 2-5 rounded tubercles on anterolateral side of carapace. Abdomen of males elongate (sides almost parallel to each other). Basal antennal segment rectangular or, if expanded distally, not forming scale-like structure **7**

7. Supraorbital borders with two very short lobes. Two to five rounded tubercles on anterolateral side of carapace. Abdomen of mature females with all segments free ..... ***MIROPALICUS*** new genus
— Supraorbital borders with 1-2 rounded or pointed lobes. Two to four narrow, pointed teeth on anterolateral side of carapace. Abdomen of mature females with segments 3-6 or 4-6 fused ..... ***PALICULUS*** new genus

Genus ***PSEUDOPALICUS*** Moosa & Serène, 1981

Pseudopalicus Moosa & Serène, 1981: 35.

TYPE SPECIES. — *Palicus serripes* Alcock & Anderson, 1895 by original designation (MOOSA & SERÈNE, 1981). Gender: masculine.

Source : MNHN, Paris

DIAGNOSIS. — Frontal border of carapace divided into four elongate or rounded lobes, inner pair more advanced anteriorly than outer pair. Anterolateral borders each with 3-4 triangular or rounded teeth. Dorsal surface of carapace typically with high, granular bosses. Eyes dorsoventrally flattened or spherical; peduncle with small, typically granular tubercles. Supraorbital borders each with two triangular or rounded lobes. Suborbital borders each typically with two rounded or square lobes. Each basal antennal segment rectangular, typically slender, without distal expansion. Epistome narrow, vertically inclined; border with at least two triangular or rounded median teeth. Chelipeds increasingly unequal with increasing body size (particularly in males), smallest typically more slender in females. First three pairs of walking legs (P2-4) with flattened (not filiform) carpi, propodi, and (with one exception) dactyli. First pair (P2) shorter than second and third pairs (P3-4); third pair slightly shorter or about as long as second pair. Borders of meri of P2-4 with thick tubercles or triangular teeth; posterior border of dactyli smooth or armed with teeth or spines. Fifth pair of pereopods (P5) reduced (0.6-0.9 CL), slender. Abdomen of males elongate (sides almost parallel to each other), with segments free, one transverse ridge each along some or all segments. Male first pleopods long, slender; basal parts straight or sinuous but not helicoidal; each distal part biramous, rarely uniramous. Abdomen of mature females with all segments free, one transverse ridge along each segment 1-4.

REDESCRIPTION. — Carapace transversely hexagonal, broader than long, with conspicuous, granular bosses that vary in sizes and arrangements. Anterolateral borders each with 3-4 triangular or rounded teeth, below which carapace slightly rounded. Confluence of branchial and mesogastric regions depressed, smooth; no conspicuous sulcus between hepatic and branchial regions. Thoracic sternite 7 typically with reduced process (episternal process) at each outer edge and posterior to insertion of fifth pair of pereopods (P5), visible dorsally as very short process below posterolateral border of carapace.

Frontal border divided into four elongate or rounded lobes, inner pair more advanced anteriorly than outer pair. Supraorbital borders each with two triangular or rounded lobes. Postorbital angles conspicuous, typically with long, pointed tips. Cornea of eyes dorsoventrally flattened, wider than base of eye peduncle, or spherical and as wide as base of peduncle; peduncle with granular tubercles at least on distal border. Orbits deep.

Suborbital borders each with two broadly rounded or rectangular lobes. Pterygostomial lobe at each anterolateral angle of buccal frame often projects ventrally.

Each basal antennal segment rectangular, usually slender, without distal expansion. Epistome narrow, not expanded dorsoventrally, vertically inclined. Border of epistome with two median teeth (plus two triangular outer processes in most species) connecting distally with each pterygostomial lobe. Meri of third maxillipeds smaller and narrower than ischia.

Chelipeds increasingly unequal with increasing size (particularly in males), smallest typically more slender in females. Fingers of larger cheliped with cutting edge, sometimes with broadly rounded teeth; those of smaller cheliped with short, triangular teeth, pollex becoming flatter with increasing size. First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair slightly shorter or as long as second. First three pairs of walking legs (P2-4) with flattened carpi, propodi, and (with one exception) dactyli; anterior (dorsal) and posterior (ventral) borders of meri with thick tubercles or triangular teeth, often rows of tubercles on dorsal and ventral surfaces; posterior border of dactyli smooth or armed with teeth or spines. Last two pairs of walking legs (P3-4) each with broad coxae, having laminar, thin-edged anterior and posterior borders. Fifth pair of pereopods (P5) reduced (0.6-0.9 CL), slender; basis-ischia and meri often short, tuberculate; one row of small spines along posterior border of dactyli.

Abdomen of mature males elongate, with both sides almost parallel to each other, with all segments free, segments 1-2 dorsoventrally compressed, one transverse ridge each along some or all segments. Male first pleopods long, slender; basal parts straight or sinuous but not helicoidal; each distal part biramous (with two typically flattened processes) or uniramous (with simple tip). Second male pleopods short, thin, slightly curved; distal segment with blunt tip.

Abdomen of mature females broad, rounded, with all segments free, segments 1-2 dorsoventrally compressed, one transverse ridge each along segments 1-4. Abdomen of immature females triangular (but broader than in males), segments 1-2 dorsoventrally compressed, 3-5 or 3-6 fused, transverse ridge along each segment 1-3 or 1-4.

Source : MNHN, Paris

SPECIES INCLUDED. — There are 11 known species of *Pseudopalicus*, by alphabetical order: *P. acanthodactylus* sp. nov., *P. amadaibai* (Sakai, 1963), *P. declivis* sp. nov., *P. glaber* sp. nov., *P. investigatoris* (Alcock, 1900), *P. macromeles* sp. nov., *P. oahuensis* (Rathbun, 1906), *P. pictus* sp. nov., *P. serripes* (Alcock & Anderson, 1895), *P. sexlobatus* (Kensley, 1969), *P. undulatus* sp. nov. A possible new species, being referred to as *Pseudopalicus* sp., is known from only one incomplete specimen.

SEXUAL DIMORPHISM. — There is a considerable difference in size between males and females, with females being larger. The chelipeds are unequal in size in both sexes but the difference is more apparent in males. The smaller cheliped is usually more slender in females. There is no evidence of differences between the sexes in the length or shape of the walking legs or fifth pair of pereopods.

DISCUSSION. — *Pseudopalicus* was established by MOOSA & SERÈNE (1981) for eight Indo-west Pacific species formerly included in *Palicus* Philippi, 1838. However, they actually examined specimens of only two species, *P. amadaibai* (Sakai, 1963) and *P. serripes* (Alcock & Anderson, 1895). Two of the original eight species, *P. fisheri* (Rathbun, 1906) and *P. cyrenae* (Ward, 1942), are being placed in synonymy with *P. investigatoris* (Alcock, 1900). The present definition of the genus has therefore been amended to include characters present in the 12 recognized species, including six new ones, that were examined in this study.

The shape of the carapace and walking legs of *Pseudopalicus* agree with the same characters of group 1 (or "typical" group) as defined by RATHBUN (1918: 184) for six western Atlantic and eastern Pacific species of *Palicus*. Four of these species have four anterior lobes as in *Pseudopalicus*: *Palicus affinis* A. Milne Edwards & Bouvier, 1899, *P. alternatus* Rathbun, 1897, *P. faxoni* Rathbun, 1897, and *P. lucasii* Rathbun, 1898. They all have two anterolateral teeth on each side of the carapace, however, unlike the four typical of *Pseudopalicus*. None of these species seem to have the convex carapace with conspicuous bosses typical of *Pseudopalicus* (see RATHBUN, 1918; WILLIAMS, 1984; MELO, 1996). *P. velerae* (Garth, 1939) from the eastern Pacific has a carapace with four anterior lobes, five anterolateral teeth on each side, and short walking legs similar to *Pseudopalicus*, but prominent episternal processes as in *Parapalicus*. It perhaps belongs to group 4 of RATHBUN on account of the presence of conspicuous episternal processes. There are also similarities with the three western Atlantic and eastern Pacific species in group 5 of RATHBUN (1918: 184): *P. dentatus* (A. Milne Edwards, 1880), *P. obesus* (A. Milne Edwards, 1880), and *P. tuberculatus* (Faxon, 1893). These species have four anterior lobes, convex carapace, conspicuous bosses, and short walking legs. They differ from *Pseudopalicus* in having two or three anterolateral teeth (see RATHBUN, 1918; MELO, 1996). There is unfortunately incomplete information on the morphology of the abdomen and no published information on the male first pleopods of these western Atlantic and eastern Pacific species.

An unidentified palicid (USNM) from off the coast of northern Peru in the eastern Pacific had a carapace very similar to that of *Pseudopalicus*, with four anterior lobes, well-developed bosses, four anterolateral teeth on each side, and two supraorbital and two suborbital lobes on each side. The male first pleopods, however, had long, helicoidal basal parts and each distal part consisting of a rounded, flat, proximal process and a very long, slightly-curved, pointed process, quite unlike the male pleopods of *Pseudopalicus* species. Furthermore, the epistome lacked teeth, each basal antennal segment had a flat, scale-like, distal extension, the fifth pereopods were thicker than those in *Pseudopalicus*, and the fingers of the chelipeds were much longer than in any species of *Pseudopalicus*.

There is very little information on the male pleopods of the Atlantic and eastern Pacific species of palicids. The male first pleopods of *Palicus caronii* (Roux, 1830) of the Mediterranean and eastern Atlantic were illustrated by MONOD (1956, figs 549-551). The pleopods of a specimen from an unknown location (SMF 4712) had sinuous basal parts and hatchet-like, uniramous distal parts. The male first pleopods of *Palicus alternatus* Rathbun, 1897 were described by WILLIAMS (1984: 482) as "stout and twisted, tip bilobed, inner lobe thinner and longer than outer" and "weaker, not twisted, and tip less spreading".

The elongate male abdomen with all segments free suggests a less specialized, and perhaps more plesiomorphic condition. The morphologies of the male first pleopods differ strikingly, although they share a sinuous, non-helicoidal basal part. The distal part can be uniramous or of several biramous patterns. Species that share a general body type and many other characters have very dissimilar male pleopods. The significance of this remains unknown. It may be suggested that the group is speciating rapidly. Another possibility is that *Pseudopalicus* may not be a natural group after all. The uniramous male pleopods of *P. investigatoris*, *P. serripes*, and *P. pictus*

Source : MNHN, Paris

sp. nov., for example, sets these species apart from their congeners. The three species, plus an undescribed species close to *P. serripes*, also share a squarish carapace and conspicuous teeth on the pterygostomial ridge.

Key to the species of *PSEUDOPALICUS*

1. Anterolateral border of carapace with four typically pointed teeth (last tooth may be very small) **2**
— Anterolateral border of carapace with three rounded teeth (last tooth may be very small) **10**

2. Dactyli of walking legs (P2-4) with teeth or spines along posterior border **3**
— Dactyli of walking legs (P2-4) entire, without teeth or spines along posterior border **8**

3. Suborbital border with one triangular or pointed tooth on inner edge. One or two sharp teeth on proximal portion of ridge that connects pterygostomial lobe with pterygostomial region of carapace (Figs 9a-b, 11b) **4**
— Suborbital border with one rectangular or rounded lobe on inner edge. No sharp teeth on proximal portion of ridge that connects pterygostomial lobe with pterygostomial region of carapace **6**

4. Dorsal surface of carapace with few, low, granular bosses. Male first pleopods with thick distal parts that are sharply bent distally (Figs 11d-e) ..... ***P. pictus*** sp. nov.
— Dorsal surface of carapace with conspicuous bosses, 10 of which cross branchial and metagastric regions. Male first pleopods with simple, straight distal parts (Figs 4b-d) ... **5**

5. Dense cluster of setae on inner surface of cheliped propodi of males. Supraorbital border with lobes having rounded tips (Fig. 12c). Dactyli of walking legs broad (P4 0.2-0.3 CL) ..... ***P. serripes*** (Alcock & Anderson, 1895)
— Inner surface of cheliped propodi of males smooth. Supraorbital border with lobes having narrow, pointed tips (Fig. 12b). Dactyli of walking legs slender (P4 0.5-0.6 CL) .... ***P. investigatoris*** (Alcock, 1900)

6. Posterior third of carapace smooth, without conspicuous, high bosses. Posterior border of carapace entire, without tubercles (Fig. 5d) ..... ***P. glaber*** sp. nov.
— Posterior third of carapace with conspicuous, high bosses. Posterior border of carapace with six low tubercles **7**

7. Two very short supraorbital lobes (Fig. 3a) ..... ***P. acanthodactylus*** sp. nov.
— Two conspicuous supraorbital lobes with rounded tips (Fig. 5b) .... ***P. amadaibai*** (Sakai, 1963)

8. Second, pointed anterolateral tooth on side of carapace larger than first, which has rounded or lobate borders (Fig. 12a). Upper and lower borders of meri of walking legs (P2-4) with thin, pointed, nearly equal tubercles ..... ***P. oahuensis*** (Rathbun, 1906)
— Anterolateral teeth gradually decrease in size posteriorly. Upper and lower borders of meri of walking legs (P2-4) with tubercles of different sizes and shapes **9**

9. Male first pleopods with distal part consisting of two processes, one broad and one thin, armed with minute teeth (Fig. 6d-e) ..... ***P. declivis*** sp. nov.
— Male first pleopods with distal part uniramous and teeth along inner and outer borders (KENSLEY, 1969, fig. 2d) ..... ***P. sexlobatus*** Kensley, 1969

10. Posterior border of carapace with 4-6 rounded, granular tubercles. Supraorbital border with two triangular lobes (Fig. 13a) ..... ***P. macromeles*** sp. nov.
— Posterior border of carapace with six low, elongate tubercles (Figs 12f, 14a). Supraorbital border with two short lobes, inner rectangular, outer rounded ..... ***P. undulatus*** sp. nov.

Source : MNHN, Paris

Pseudopalicus acanthodactylus sp. nov.

Figs 3, 5a, 55, 60a

MATERIAL EXAMINED. — **New Caledonia**. CHALCAL 2: stn CC 2, 24°55.48'S, 168°21.29'E, 500 m, 28.10.1986: 1 ♂, 2 ♀ (MNHN-B 26861); 1 ♀ (MNHN-B 26862). — Stn CP 21, 24°54.00'S, 168°21.61'E, 500 m, 28.10.1986: 1 ♀ (MNHN-B 26863). — Stn DW 72, 24°54.5'S, 168°22.3'E, 527 m, 28.10.1986: 3 ♀ (MNHN-B 26864). — Stn DW 74, 24°40.36'S, 168°38.38'E, 650 m, 29.10.1986: 1 ♀ (MNHN-B 26676). — Stn DW 75, 24°39.31'S, 168°39.67'E, 600 m, 29.10.1986: 2 ♂ paratypes 6.9 x 9.0 mm, 7.3 x 9.7 mm (MNHN-B 26675), 1 ♀ (MNHN-B 26865). — Stn DW 76, 23°40.5'S, 167°45.2'E, 470 m, 30.10.1986: 2 ♂, 5 ♀ (MNHN-B 26866). — Stn DW 77, 23°38.35'S, 167°42.68'E, 435 m, 30.10.1986: 3 ♀ (MNHN-B 26867).

SMIB 3: stn DW 6, 24°56'S, 168°21'E, 505 m, 21.05.1987: 1 ♂, 4 ♀ (MNHN-B 26868). — Stn DW 9, 24°42'S, 168°08'E, 265 m, 21.05.1987: 1 ♂ (MNHN-B 26869). — Stn DW 12, 23°37.7'S, 167°41.5'E, 470 m, 22.05.1987: 1 ♂, 2 ♀ (MNHN-B 26870). — Stn DW 13, 23°37.5'S, 167°41.6'E, 448 m, 22.05.1987: 1 ♂, 2 ♀ (MNHN-B 26871).

SMIB 4: stn DW 58, 22°59.8'S, 167°24.2'E, 560 m, 9.03.1989: 1 ♀ paratype 10.6 x 13.0 mm (MNHN-B 26674).

BERYX 11: stn CP 7, 24°55'S, 168°21'E, 510-550 m, 15.10.1992: 1 ♀ (MNHN-B 26872). — Stn CP 8, 24°54'S, 168°21'E, 540-570 m, 15.10.1992: 1 ♂ (MNHN-B 26873). — Stn CP 10, 24°53'S, 168°21'E, 565-600 m, 15.10.1992: 2 ♀ (MNHN-B 26874). — Stn DW 27, 23°37'S, 167°41'E, 460-470 m, 18.10.1992: 1 ♀ paratype 12.3 x 14.9 mm (MNHN-B 26673), 2 ♂, 2 ♀ (MNHN-B 26737). — Stn CP 32, 23°38'S, 167°43'E, 420-460 m, 18.10.1992: 1 ♀ (MNHN-B 26875).

SMIB 8: stn DW 146, 24°55.2'S, 168°21.7'E, 514-522 m, 27.01.1993: 1 holotype ♂ 8.9 x 10.5 mm (MNHN-B 26672). — Stn DW 147, 24°54.9'S, 168°21.8'E, 508-532 m, 27.01.1993: 1 ♀ 9.6 x 13.5 mm (MNHN-B 26876). — Stn DW 150, 24°54.3'S, 168°22.2'E, 519-530 m, 27.01.1993: 1 ♂, 1 ♀ (MNHN-B 26877). — Stn DW 152, 24°54.3'S, 168°22.2'E, 514-530 m, 27.01.1993: 1 ♀ (MNHN-B 26878). — Stn DW 166, 23°37.8'S, 167°42.7'E, 433-450 m, 29.01.1993: 3 ♀ (MNHN-B 26879). — Stn DW 167, 23°38.1'S, 168°43.1'E, 430-452 m, 29.01.1993: 1 ♂, 3 ♀ (MNHN-B 26880), 1 ♀ 13.8 x 16.7 mm (MNHN-B 26738). — Stn DW 168, 23°37.7'S, 168°42.5'E, 433-450 m, 29.01.1993: 1 ♂, 5 ♀ (MNHN-B 26881). — Stn DW 169, 23°37.7'S, 167°42.5'E, 447-450 m, 29.01.1993: 4 ♀ (MNHN-B 26882).

SMIB 10: stn DW 202, 24°55'S, 168°22'E, 525-513 m, 10.01.1995: 1 ♀ (MNHN-B 26883).

LITHIST: stn CP 2, 23°37.07'S, 167°41.14'E, 442 m, 10.08.1999: 3 ♀, 1 ♀ (MNHN-B 26969). — Stn CP 3, 23°37.01'S, 167°49'E, 447 m, 10.08.1999: 1 ♂, 3 ♀ (MNHN-B 26967). — Stn DW 5, 23°38.25'S, 167°42.94'E, 433-500 m, 11.08.1999: 8 ♀ (MNHN-B 26968), 1 ♂ paratype 8.4 x 10.3 mm, 1 ♀ paratype 12.0 x 14.8 mm (USNM), 1 ♂ paratype 8.4 x 10.4 mm, 1 ♀ paratype 11.8 x 14.4 mm (ZRC 1999.1425-1426). — Stn CP 8, 24°54.24'S, 168°21.35'E, 540 m, 11.08.1999: 1 ♀ (MNHN-B 26970). — Stn CP 11, 24°46.69'S, 168°08.33'E, 254-283 m, 11.08.1999: 1 ♂, 1 ♀ (MNHN-B 26971).

TYPES. — *Holotype*: 1 ♂ 8.9 x 10.5 mm, SMIB 8, stn DW 146 (MNHN-B 26672).

Paratypes: 2 ♂ 6.9 x 9.0 mm, 7.3 x 9.7 mm, CHALCAL 2, stn DW 75 (MNHN-B 26675); 1 ♀ 10.6 x 13.0 mm, SMIB 4, stn DW 58 (MNHN-B 26674); 1 ♀ 12.3 x 14.9 mm, BERYX 11, stn DW 27 (MNHN-B 26673); 1 ♂ 8.4 x 10.3 mm, 1 ♀ 12.0 x 14.8 mm, LITHIST, stn DW 5 (USNM); 1 ♂ 8.4 x 10.4 mm, 1 ♀ 11.8 x 14.4 mm, LITHIST, stn DW 5 (ZRC 1999.1425-1426).

TYPE LOCALITY. — Norfolk Ridge, south of New Caledonia, 24°55.2'S, 168°21.7'E, 514-522 m.

DIAGNOSIS. — Carapace (Figs 3a, 5a, 60a) with four anterolateral teeth on each side, first tooth usually rounded, blunt, second and third larger, pointed, and fourth very small. Dorsal surface of carapace with medium-size bosses, 12 of which form an almost straight row across branchial and metagastric regions in larger specimens; posterior border with six low, elongate tubercles. Supraorbital borders each with two very short lobes. Suborbital borders (Fig. 3b) each with one broad, square outer lobe; one higher, narrower, rounder inner lobe. Outer surfaces of cheliped propodi each with 2-3 rows of blunt tubercles. Dactyli of walking legs (P2-4) with short, thick spines along posterior border (2-4 spines in P4; Fig. 3c). Abdomen of mature males (Fig. 3d) with all segments free, one complete transverse ridge along each segment 1-3, incomplete ridge along median portion of segment 4. Male first pleopods (Figs 3e-f) with sinuous basal parts; each distal portion with broad ventral process having small teeth, two dorsal, wing-like extensions. Abdomen of mature females with all segments free (Fig. 3g), one complete transverse ridge along each segment 1-4.

Source : MNHN, Paris

Color: The carapace of the live male holotype (Fig. 60a) had a pattern of irregular, very fine yellow blotches on a red-brown background. The same pattern was repeated on the chelipeds and walking legs. The distalmost tubercle on each eye peduncles was red, color still visible in specimens that had been preserved for one month.

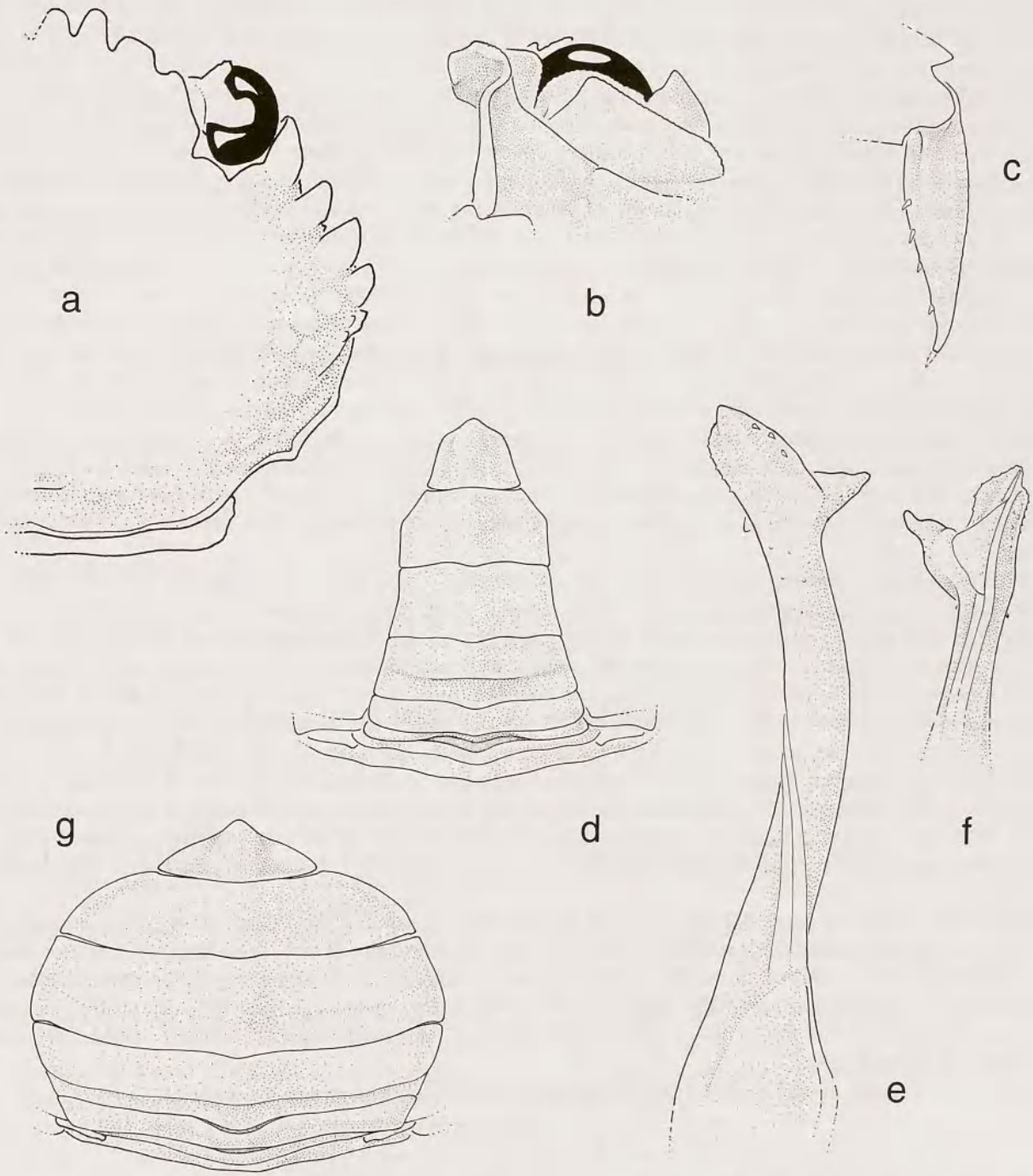


FIG. 3. — *Pseudopalicus acanthodactylus* sp. nov.: **a-f**, ♂ holotype 8.9 x 10.5 mm, Norfolk Ridge, south of New Caledonia, SMIB 8, stn DW 146, 514-522 m (MNHN-B 26672): **a**, carapace, dorsal surface; **b**, suborbital border; **c**, dactylus, right fourth pereopod, dorsal view; **d**, abdomen; **e**, left male first pleopod, ventral view; **f**, left male first pleopod, distal part, lateral (inner side) view. — **g**, ♀ paratype 10.6 x 13.0 mm, Norfolk Ridge, south of New Caledonia, SMIB 4, stn DW 58, 560 m (MNHN-B 26674): abdomen.

Source : MNHN, Paris

DESCRIPTION. — Carapace (Figs 3a, 5a, 60a) transversely hexagonal, wider than long (CW/CL = 1.2-1.3); dorsal surface covered with coarse granules and rows of conspicuous granular bosses. Confluence of branchial and mesogastric regions depressed, granular, usually darker in color. Anterolateral borders of carapace each with four anterolateral teeth, first usually rounded, blunt, second and third larger, pointed, and fourth very small. Dorsal surface of carapace with medium-size bosses, 12 of which form an almost straight row across branchial and metagastric regions in larger specimens (up to 14, not in straight row, in smaller specimens). Posterior border with six low, elongate tubercles (almost continuous in larger specimens) and no plumose setae.

Frontal border of carapace divided into four narrow, rounded lobes, inner lobes longer and typically more pointed, particularly in larger specimens. Borders between frontal lobes and supraorbital borders anteriorly rounded (slightly pointed in some specimens), folded upward slightly, and ending in sharp angle, forming very shallow, U- or L- shaped fissure before supraorbital border. Supraorbital borders each with two very short, nearly straight, or slightly rounded lobes. Postorbital angles short (not extending beyond dorsal border of retracted eye), slightly pointed inward. Cornea of eyes dorsoventrally flattened, wider than base of short eye peduncle; each peduncle with two flat, granular tubercles on distal border.

Suborbital borders (Fig. 3b) each with one broad, square outer lobe; one higher, narrower, rounder inner lobe. Pterygostomial lobes project ventrally, forming flat, semicircular structure posterior to each inner suborbital lobe.

Each basal antennal segment slender, rectangular; flagellum long, with few, simple setae. Epistome vertically inclined, with two broad (rounded or pointed), flat median teeth, each flanked by narrow, pointed outer process and thin, rounded margin before pterygostomial lobe. Inner border of ischia of third maxillipeds straight; surface coarsely granular, upper borders rounded. Meri much narrower than ischia; straight-edged, triangular upper borders.

Dorsal and outer borders of cheliped propodi with rows of rounded, sometimes elongate tubercles. Fingers of largest cheliped with cutting edges (rounded teeth in small specimens), 4-8 rounded to triangular teeth in smallest cheliped. Carpi short, outer borders with low, rounded tubercles; meri slender, outer borders with low, rounded tubercles.

First three pairs of walking legs (P2-4; Fig. 5a, 60a) flattened. Upper and lower borders of meri with tubercles of different sizes and shapes (some pointed, some rounded; smaller but on two anterior rows in P2); distalmost tubercle on each anterior border much wider at base, much higher, slender, pointed, directed distally (only in P2-3 in some small specimens). Anterior borders of carpi tuberculate; borders of propodi entire. Each P2 with one dorsal, one ventral carina on carpus; two dorsal, two ventral carinae on propodus; one dorsal, two ventral carinae, 0-3 spines along posterior border of dactylus. Each P3 with one dorsal, one ventral row of tubercles on merus; two dorsal, two ventral carinae on carpus; one dorsal, two ventral carinae on propodus; one dorsal, two ventral carinae, 0-4 spines along posterior border of dactylus. Each P4 with two dorsal, one ventral rows of tubercles on merus (absent in some); two dorsal, two ventral carinae on each carpus and propodus; one dorsal, two ventral carinae, 2-4 short, thick spines along posterior border of dactylus (Fig. 3c). Meri of all walking legs with scattered plumose setae; dorsal surfaces of propodi and dactyli of P3-4 each with one row of conspicuous plumose setae along anterior border.

First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair slightly shorter than second. Fifth pair of pereopods (P5) short (0.7-0.8 CL); each merus wide in larger specimens (slender in smaller specimens), tuberculate surface, 4-5 triangular tubercles (proximal largest) along posterior border, and scattered plumose setae; each propodus with low tubercles (2-4 short spines in largest specimens) along posterior border; each dactylus with row of 11-13 short, thick spines along posterior border, 2-3 distally on anterior border, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.1	1.8-2.0	1.5-2.0	0.7-0.8
Merus length/CL	0.3-0.4	0.6	0.4-0.6	0.2
Dactylus length/Cl	0.2	0.3-0.4	0.3	0.2

Abdomen of mature females (Fig. 3g) with all segments free. One transversal ridge along each segment 1-4.

Source : MNHN, Paris

Abdomen of mature males (Fig. 3d) with all segments free. One complete transverse ridge along each segment 1-3, incomplete ridge along median portion of segment 4. Male first pleopods (Fig. 3e-f) with sinuous basal parts; each distal part with broad ventral process with small teeth and two dorsal, wing-like extensions.

DISCUSSION. — *P. acanthodactylus* can be easily distinguished from congeners by its short supraorbital lobes, which make the eyes seem prominent, and the short, thick spines on the posterior border of the dactyli of the walking legs (P2-4; Fig. 3c).

SIZE. — Maximum size among specimens examined: 13.8 x 16.7 mm (female, MNHN-B 26738); 9.4 x 11.5 mm (male, MNHN-B 26737).

ETYMOLOGY. — From *akantha*, Greek for spine, and *daktylos*, Greek for finger, in reference to the diagnostic spiny dactyli of the walking legs (P2-4).

DISTRIBUTION. — Known only from the Norfolk Ridge south of New Caledonia (Fig. 55). Depth: 265-650 m.

Pseudopalicus amadaibai (Sakai, 1963)

Figs 4a, 5b, 53

Palicus oahuensis - BALSS, 1922: 120, fig. 6. — YOKOYA, 1933: 206, 212 [non *Palicus oahuensis* Rathbun, 1906].
Cymopolia oahuensis - SAKAI, 1939: 609, fig. 90a; 1956: 52. — NAKAZAWA & SAKAI, 1947: 665, unnumb. fig. [non *Palicus oahuensis* Rathbun, 1906].
Palicus amadaibai Sakai, 1963: 227, fig. 7a. — SAKAI, 1965: 183, pl. 89, fig. 1; 1976: 593, pl. 205, fig. 1. — SERÈNE, 1968: 96. — TAKEDA & MIYAKE, 1969: 464. — MURAOKA, 1998: 49.
Pseudopalicus amadaibai - MOOSA & SERÈNE, 1981: 39, fig. 6, pl. 2, fig. B. — TAKEDA, 1982a: 205, fig. 608.

MATERIAL EXAMINED. — **Japan**. *Tosa Bay*. Mimase, 1959, dry specimen with red tag, possible part of type material: 1 ♀ 14.2 x 17.0 mm (SMF 24698). — Kochi, Mimase, K. SAKAI coll.: 1 ♂ 12.6 x 14.5 mm (KPM-NH 107132). — K. SAKAI coll., 15.04.1963: 1 ♀ 15.5 x 18.6 mm (SMF 24699); 20.03.1964: 1 ♀ (SMF 24700); 10.1961-04.1963: 1 ♂ (SMF 24701).

Sagami Bay. Okinoyama Bank, 34°59'N, 139°39'E, 105-113 m, coarse sand and shell fragments, T. KOMAI coll., 21.04.1995: 1 ♀ (CBM-ZC 2004).

Kii Peninsula. Off Shionomisaki, 33°26.13'N, 135°40.64'E, 160 m, S. NAGAI coll., 16.01.1997: 1 ♀ (CBM-ZC 3602); 33°26.72'N, 135°29.20'E, 180 m: 1 juv. ♂ (CBM-ZC 4953). — Off Kirimezaki, 150-180 m, H. IKEDA coll., 09.1981: 1 ♂ (HSM). — Kii Strait, trawl, M. OZAKI coll. from Sakaihama fish market: 1 ♂, 1 ♀ (SMF 24702).

Goto Islands. *"Soyo Maru"*: stn 440, 152 m, 19.07.1929: 1 ♂ (KMNH).

No location. 1 ♀ (SMF 24703). — 1 ♀ (SMF 24704). — 1 ♀ (SMF 24705). — 1 ♀ (SMF 24706).

Philippine Islands. *Verde Island Passage*. MUSORSTOM 2: stn DG 32, 13°40'N, 120°54'E, 192-220 m, 24.11.1980: 1 ♂ 12.1 x 14.7 mm (MNHN-B 26804).

Indonesia. *Tanimbar Islands*. KARUBAR: stn DW 49, 08°00'S, 132°59'E, 206-209 m, 29.10.1991: 1 ♂ (MNHN-B 26739). — Stn CP 86, 09°26'S, 131°13'E, 223-225 m, 4.11.1991: 1 ♀ 12.3 x 14.5 mm (MNHN-B 26828).

New Caledonia. BATHUS 1: stn DW 690, 20°32.94'S, 165°00.83'E, 352 m, 16.03.1993: 1 juv. ♂ (MNHN-B 26815).

Fiji. BORDAU 1: stn DW 1450, 16°44'S, 179°58'E, 327-420 m, 4.03.1999: 1 ♂, 1 ♀ (MNHN-B 27133).

TYPES. — *Holotype* of *Palicus amadaibai* Sakai, 1963: 1 ♂ 12 x 15 mm (SAKAI, 1963), EMPEROR OF JAPAN coll. (Showa Memorial Institute, National Science Museum, Tsukuba, Japan; NSMT-Cr R: 2506).

Allotype: 1 ♀, same locality as holotype. Deposit unknown.

Paratypes: 1 ♂, 2 ♀, west of Jyogashima light, Sagami Bay, Japan, 65-85 m, EMPEROR OF JAPAN coll. — 2 ♂, 1 ♀, Tosa Bay, Japan, K. SAKAI coll. Deposit unknown.

Possible paratype: 1 ♀ 14.2 x 17.0 mm, Tosa Bay, Japan (SMF 24698).

TYPE LOCALITY. — Amadaiba fishing grounds off Hayama (Kannonzuka-dashi, Aoyama-dashi), Sagami Bay, Japan, 65-85 m.

Source : MNHN, Paris

DIAGNOSIS. — Carapace (Fig. 5b) with four broad, slightly pointed anterolateral teeth on each side; teeth decrease in size posteriorly. Dorsal surface of carapace with large granular bosses, 12 of which form an almost straight row across branchial and metagastric regions in large specimens; posterior border with six low, elongate tubercles (almost continuous in larger specimens). Supraorbital borders each with two rounded lobes. Suborbital borders each with two broad, slightly rounded to straight-edged lobes; inner border slightly higher than outer. Dorsal borders of cheliped propodi each with row of thin, elongate, rounded tubercles; outer surface with scattered blunt tubercles. Dactyli of walking legs (P2-4) with short, thick spines along posterior border (2-3 in P4). Abdomen of mature males with all segments free, one complete transverse ridge along each segment 1-3, incomplete ridge along median portion of segment 4. Male first pleopods (Fig. 4a; MOOSA & SERÈNE, 1981, fig. 6) with sinuous basal parts; each distal portion with four distal tips (three thick, mammillate; one slender with spinules). Abdomen of mature females with all segments free, one complete transverse ridge along each segment 1-4 (very low ridge may be present along segment 5).

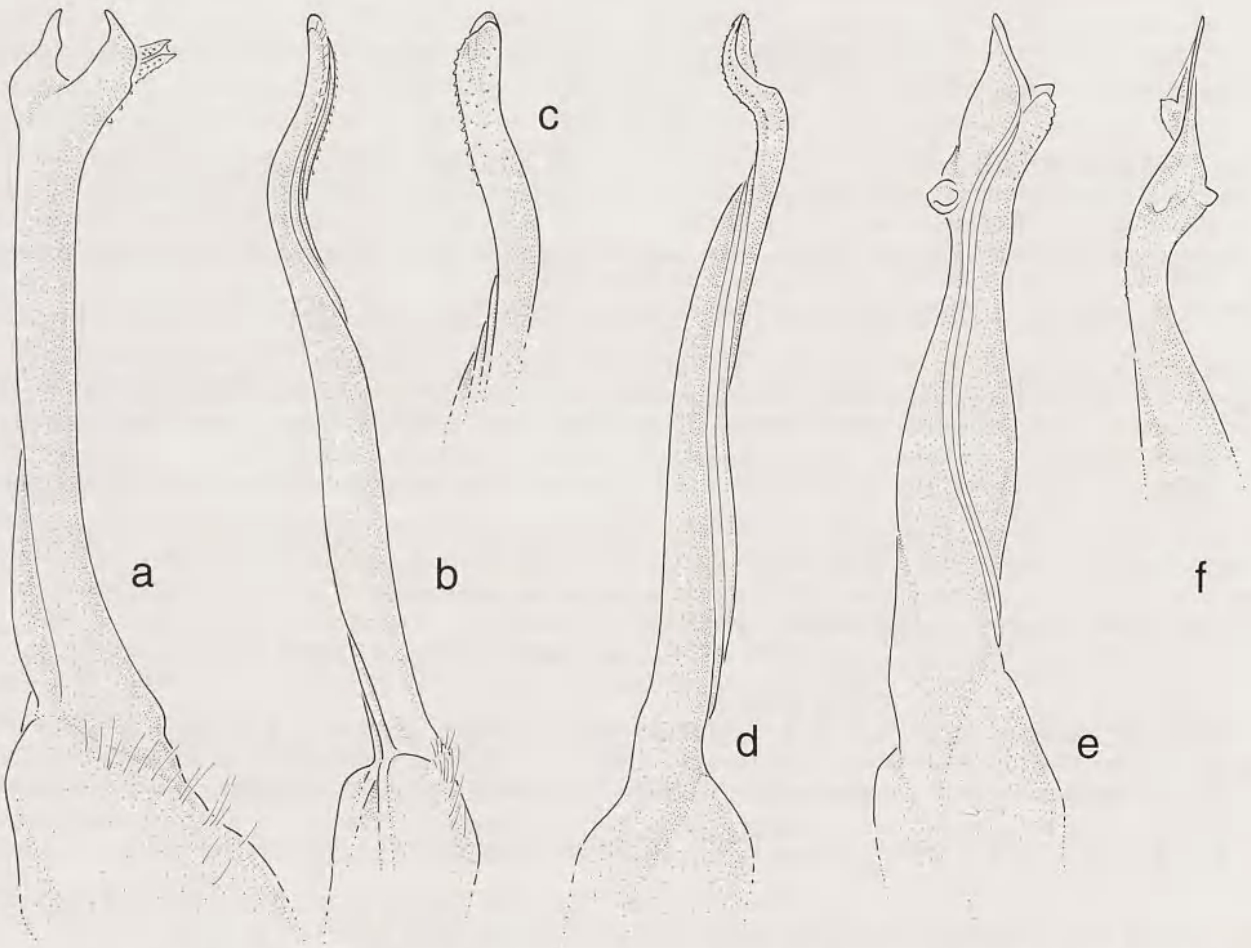


FIG. 4. — **a**, *Pseudopalicus amadaibai* (Sakai, 1963), ♂ 12.1 x 14.7 mm, Verde Island Passage, Philippine Islands, MUSORSTOM 2, stn DG 32, 192-220 m (MNHN-B 26804): left male first pleopod, ventral view. — **b-c**, *Pseudopalicus investigatoris* (Alcock, 1900), ♂ 10.3 x 12.0 mm, South China Sea, Philippine Islands, MUSORSTOM 1, stn 57, 107-96 m (MNHN-B 26805): **b**, left male first pleopod, ventral view; **c**, left male first pleopod, distal part, dorsal view. — **d**, *Pseudopalicus serripes* (Alcock & Anderson, 1895), ♂ 10.4 x 11.0 mm, Seychelles, REVES 2, stn 21, 55-60 m (MNHN-B 26750): left male first pleopod, lateral (inner side) view. — **e-f**, *Pseudopalicus oahuensis* (Rathbun, 1906), ♂ 7.8 x 10.4 mm, Norfolk Ridge, south of New Caledonia, SMIB 4, DW 56, 260 m (MNHN-B 26806): **e**, left male first pleopod, lateral (outer side) view; **f**, left male first pleopod, distal part, ventral view.

Source : MNHN, Paris

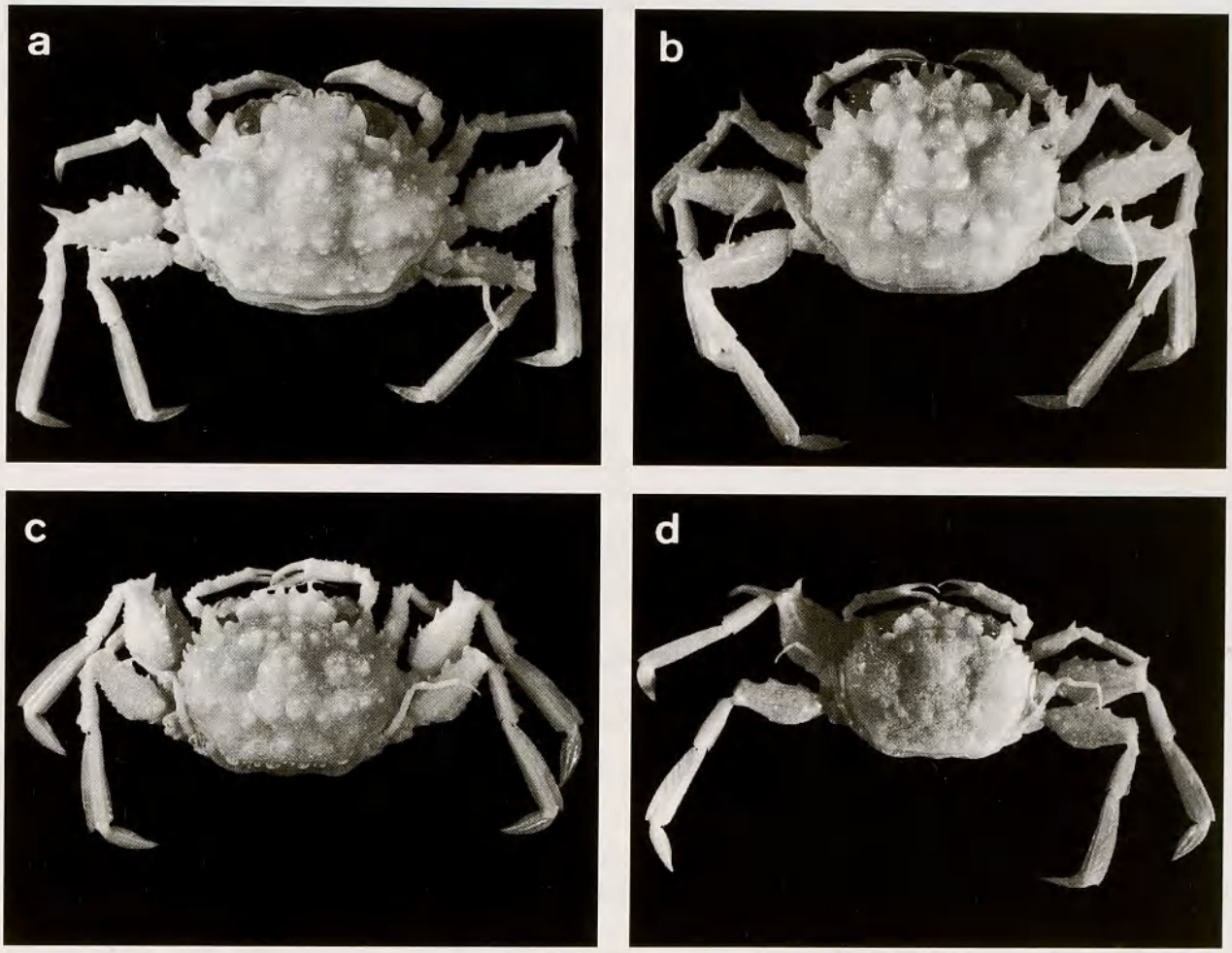


FIG. 5. — **a**, *Pseudopalicus acanthodactylus* sp. nov., ♀ 9.6 x 13.5 mm, Norfolk Ridge, south of New Caledonia, CHALCAL 2, stn DW 74, 650 m (MNHN-B 26676): dorsal view. — **b**, *Pseudopalicus amadaibai* (Sakai, 1963): ♀ 12.3 x 14.5 mm, Tanimbar Islands, Indonesia, KARUBAR, stn CP 86, 223-225 m (MNHN-B 26828): dorsal view. — **c**, *Pseudopalicus declivis* sp. nov., ♀ paratype 15.5 x 18.1 mm, Grand Passage, north of New Caledonia, MUSORSTOM 4, stn DW 196, 450 m (MNHN-B 26680): dorsal view. — **d**, *Pseudopalicus glaber* sp. nov., ♀ paratype 9.8 x 12.3 mm, Norfolk Ridge, north of New Caledonia, SMIB 5, stn DW 103, 315 m (MNHN-B 26687): dorsal view.

DISCUSSION. — Comparison of material collected throughout the western Pacific with material from the type locality, central Japan (including material examined by T. SAKAI and most probably some of his type material), confirms previous characterizations of the species. SAKAI (1963) named his new species after the Amadaiba fishing grounds in Sagami Bay, Japan, but erroneously used "amadaibai" instead of the correct "amadaibaiensis" to name the species.

MOOSA & SERÈNE (1981) noted that no mention was made in SAKAI's description of the presence of spines along the posterior border of the walking legs, even though they were shown in SAKAI (1963, fig. 7a). It is assumed that MOOSA & SERÈNE were referring specifically to the dactyli of the walking legs, which SAKAI (1963: 228) described as having "two or three denticles".

Other characteristics of *P. amadaibai* include a carapace with a frontal border that is divided into four narrow and rounded lobes (inner lobes are more pointed in large specimens), followed by a broad, rounded, and folded-upward lobe before the supraorbital border. The postorbital angles are short (not extending beyond the dorsal border of the retracted eye) and only slightly pointed inward. Each basal antennal segment is slender and rectangular (but slightly expanded along the outer border in large specimens) and slightly tuberculate. Each eye peduncle has two low,

Source : MNHN, Paris

granular tubercles on the distal border and, in alcohol-preserved specimens, large red-orange spots ventrally. The pterygostomial lobes project ventrally, forming a flat, semicircular structure (triangular when seen ventrally) posterior to each inner suborbital lobe. The epistome is vertically inclined, with two short, rounded median teeth flanked on each side by a triangular outer process and a thin, rounded margin before joining pterygostomial lobe. The third pair of walking legs (P4) have slender meri (0.4-0.5 CL; Fig. 5b) each armed with one row of teeth along upper border and one conspicuously pointed distal tooth; the dactyli are slender (0.3 CL), each armed with 2-3 microscopic teeth along the posterior border. The fifth pair of pereopods (P5) are short (0.8 CL), each merus is smooth or with several low tubercles along the posterior border, and dactylus with a row of 4-5 thick spines along the posterior border, 1-3 distally on the anterior border.

P. amadaibai was initially confused with *P. oahuensis* (Rathbun, 1906) (BALSS, 1922; YOKOYA, 1933; SAKAI, 1939; 1956; NAKAZAWA & SAKAI, 1947) but their resemblance is only superficial. In addition to the clear differences between the male first pleopods, the dactyli of the walking legs (P2-4) are unarmed in *P. oahuensis* but armed in *P. amadaibai*.

MOOSA & SERÈNE (1981) pointed out rather superficial similarities between *P. amadaibai* and *P. investigatoris*, which unfortunately they did not examine. *P. investigatoris* can be easily distinguished by its very pointed anterolateral teeth, presence of a pointed tooth on the inner border of the suborbital border, and very simple male first pleopods (see discussion for *P. investigatoris* below).

The figure of the male first pleopods given by MOOSA & SERÈNE (1981, fig. 6) shows three thick and pointed processes, two being of the same size, with the third smaller. Most of the specimens examined in this study only had two equal processes (Fig. 4a).

An unusual abnormality, the presence of one inner lobe along the anterior border of the carapace instead of the normal two (for a total of three lobes instead of four), was observed in a male from the Tanimbar Islands, Indonesia (MNHN-B 26739). It was probably due to damage and subsequent growth.

SIZE. — Maximum size among specimens examined: 15.5 x 18.6 mm (female, SMF 24699); 12.6 x 14.5 mm (male, KPM-NH 107132).

DISTRIBUTION. — Japan (BALSS, 1922; YOKOYA, 1933; SAKAI, 1939, 1956, 1963, 1965, 1976; NAKAZAWA & SAKAI, 1947; TAKEDA & MIYAKE, 1969; TAKEDA, 1982a; MURAOKA, 1998), and the Philippine Islands (MOOSA & SERÈNE, 1981). It is here recorded for the first time from the Arafura Sea (Indonesia), New Caledonia and Fiji (Fig. 53). SAKAI (1976) recorded it from soft bottoms. Depth: known reliably between 65 m (SAKAI, 1963) and 352 m, also collected in a trawl between 327-420 m.

Pseudopalicus declivis sp. nov.

Figs 5c, 6, 55

MATERIAL EXAMINED. — **Philippine Islands**. *South China Sea.* MUSORSTOM 2: stn CP 19, 14°00'N, 120°16'E, 189-192 m, 22.11.1980: 1 ♂, 2 ♀ (MNHN-B 26740).

Indonesia. *Kai Islands.* KARUBAR: stn DW 18, 05°18'S, 133°01'E, 205-212 m, 24.10.1991: 1 juv. ♂ (MNHN-B 26884).

Chesterfield Islands. MUSORSTOM 5: stn 379, 19°53.20'S, 158°39.50'E, 370-400 m, 20.10.1986: 1 ♂ paratype 10.2 x 12.0 mm (MNHN-B 26678).

Vanuatu. MUSORSTOM 8: stn CP 1024, 17°48.21'S, 168°38.77'E, 335-370 m, 28.09.1994: 1 ♀ (MNHN-B 26885).

New Caledonia. *"Vauban"* DREDGINGS 1978: stn D3, 22°17'S, 167°12'E, 390 m, 23.05.1978: 1 ♀ (MNHN-B 26886). — Stn D4, 22°17'S, 167°13'E, 400 m, 23.05.1978: 1 ♂ (MNHN-B 26887). — Stn D16, 22°17'S, 167°12'E, 390 m, 23.05.1978: 1 ♂ (MNHN-B 26888).

BIOCAL: stn CP 105, 21°31'S, 166°22'E, 330-335 m, 8.09.1985: 1 ♂ (MNHN-B 26889), 1 ♂ paratype 10.5 x 12.9 mm, 1 ♀ paratype 14.5 x 17.8 mm (ZRC 1999.1427-1428).

MUSORSTOM 4: stn CP 180, 18°56'S, 163°17.7'E, 440 m, 18.09.1985: 1 ♂ (MNHN-B 26890). — Stn DW 181, 18°57.2'S, 163°22.4'E, 350 m, 18.09.1985: 3 ♀ (MNHN-B 26891). — Stn CP 193, 18°56.3'S, 163°23.2'E, 415 m, 19.09.1985: 2 ♂, 3 ♀ (MNHN-B 26892). — Stn DW 196, 18°55.0'S, 163°23.7'E, 450 m, 20.09.1985: 1 ♀ paratype 15.5 x 18.1 mm (MNHN-B 26680), 1 ♂, 1 ♀ (MNHN-B 26893). — Stn DW 222, 22°57.6'S, 167°33.0'E, 410-440 m, 30.09.1985: 1 ♀ paratype 14.2 x 16.3 mm (MNHN-B 26681).

Source : MNHN, Paris

LAGON: stn DW 1152, 18°58.2'S, 163°23.9'E, 335 m, shark teeth and stylasterids, 29.10.1989: 1 ♂ (MNHN-B 26894).

SMIB 6: stn DW 120, 18°58.5'S, 163°25.6'E, 310-325 m, sponges and stylasterids, 3.03.1990: 1 ♀ paratype 11.5 x 12.6 mm (MNHN-B 26682).

SMIB 8: stn DW 189, 23°17.6'S, 168°05.5'E, 400-402 m, 31.01.1993: 1 ♀ (MNHN-B 26895).

BATHUS 1: stn CP 701, 20°57.54'S, 165°35.86'E, 302-335 m, 18.03.1993: 1 ♂, 3 ♀ (MNHN-B 26896), 1 ♂ paratype 10.4 x 12.6 mm, 1 ♀ paratype 11.4 x 14.1 mm (USNM). — Stn CP 710, 21°43.16'S, 166°36.35'E, 320-386 m, 19.03.1993: 1 ♀ (MNHN-B 26897).

BATHUS 2: stn DW 718, 22°46.70'S, 167°14.45'E, 430-436 m, 11.05.1993: 1 ♂ (MNHN-B 26898). — Stn DW 729, 22°52.42'S, 167°11.90'E, 400 m, 12.05.1993: 1 ♂ (MNHN-B 26899). — Stn DW 730, 23°02.56'S, 166°58.30'E, 397-400 m, 12.05.1993: 2 ♂, 1 ♀ (MNHN-B 26900). — Stn 737, 23°03.42'S, 166°59.97'E, 350-400 m, 13.05.1993: 1 ♂ 12.4 x 14.7 mm (MNHN-B 26741).

BATHUS 3: stn DW 827, 23°22'S, 167°01'E, 381-469 m, sand and gravel, 29.11.1993: 1 ♂ holotype 11.1 x 13.4 mm (MNHN-B 26677). — Stn CP 847, 23°03'S, 166°58'E, 405-411 m, 1.12.1993: 3 ♀ (MNHN-B 26901).

BATHUS 4: stn DW 894, 20°15.77'S, 163°52.03'E, 245-268 m, 3.08.1994: 1 ♂ (MNHN-B 26902). — Stn DW 925, 18°54.55'S, 163°23.75'E, 370-405 m, 7.08.1994: 1 ♂, 1 ♀ (MNHN-B 26903). — Stn DW 926, 18°56.80'S, 163°25.36'E, 325-330 m, 7.08.1994: 2 ♂, 1 ♀ (MNHN-B 26904). — Stn DW 927, 18°55.48'S, 163°22.11'E, 452-444 m, 7.08.1994: 1 ♂ (MNHN-B 26905).

HALICAL 1: stn DW 1, 18°54.96'S, 163°24'E, 380-400 m, 23.11.1994: 1 ♂ (MNHN-B 26906). — Stn DW 4, 18°55'S, 163°23.29'E, 350-365 m, 29.11.1994: 1 ♂ paratype 10.4 x 11.0 mm (MNHN-B 26679).

Loyalty Islands. MUSORSTOM 6: stn DW 406, 20°40.65'S, 167°06.80'E, 373 m, 15.02.1989: 1 ♀ (MNHN-B 26907). — Stn DW 460, 21°01.72'S, 167°31.45'E, 420 m, 20.02.1989: 1 ♂ (MNHN-B 26908). — Stn CP 464, 21°02.30'S, 167°31.60'E, 430 m, 21.02.1989: 1 ♀ (MNHN-B 26909).

TYPES. — *Holotype*: 1 ♂ 11.1 x 13.4 mm, BATHUS 3, stn DW 827 (MNHN-B 26677).

Paratypes: 1 ♂ 10.2 x 12.0 mm, MUSORSTOM 5, stn 379 (MNHN-B 26678); 1 ♂ 10.4 x 11.0 mm, HALICAL 1, stn DE 4 (MNHN-B 26679); 1 ♀ 15.5 x 18.1 mm, MUSORSTOM 4, stn DW 196 (MNHN-B 26680); 1 ♀ 14.2 x 16.3 mm, MUSORSTOM 4, stn DW 222 (MNHN-B 26681); 1 ♀, New Caledonia 11.5 x 12.6 mm, SMIB 6, stn DW 120 (MNHN-B 26682); 1 ♂ 10.4 x 12.6 mm, 1 ♀ 11.4 x 14.1 mm, BATHUS 1, stn CP 701 (USNM); BIOCAL, stn CP 105, 1 ♂ paratype 10.5 x 12.9 mm, 1 ♀ paratype 14.5 x 17.8 mm (ZRC 1999. 1427-1428).

TYPE LOCALITY. — Norfolk Ridge, south of New Caledonia, 23°22'S, 167°01'E, 381-469 m, sand and gravel.

DIAGNOSIS. — Carapace (Figs 5c, 6a) with four pointed anterolateral teeth on each side; teeth gradually decrease in size posteriorly. Dorsal surface of carapace with small granular bosses, 10 of which form an almost straight row across branchial and metagastric regions; posterior border with 6-8 low, elongate tubercles. Supraorbital borders each with two slightly rounded to triangular lobes. Suborbital borders (Fig. 6b) each with one square or slightly rounded outer lobe; one slightly higher, rounded, or obliquely-directed inner lobe. Outer surfaces of cheliped propodi with scattered blunt tubercles of various sizes. Dactyli of walking legs (P2-4) very slender, with posterior borders entire (Fig. 6c). Abdomen of mature males with all segments free, one complete transverse ridge along each segment 1-4 (low ridge may be present along median portion of 5-6). Male first pleopods (Figs 6d-e) with sinuous basal parts; each distal part with two processes, inner broad, longer, outer narrow, shorter, armed with minute teeth. Abdomen of mature females with all segments free, one complete transverse ridge along each segment 1-4 (low ridge sometimes along segment 5).

DESCRIPTION. — Carapace (Figs 5c, 6a) transversely hexagonal, wider than long (CW/CL = 1.1-1.2). Anterolateral borders of carapace each with four pointed anterolateral teeth gradually decreasing in size posteriorly (last tooth may be missing or greatly reduced in smaller specimens). Dorsal surface of carapace with medium-size, rounded, granular bosses, 10 of which form an almost straight row across branchial and metagastric regions. Posterior border with 6-8 low, elongate tubercles and elongate plumose setae.

Frontal border of carapace divided into four narrow, rounded lobes, inner lobes longer and typically more pointed (outer lobes always shorter but may be pointed in some specimens). Borders between frontal lobes and supraorbital borders straight, folded upward, slightly pointed anteriorly in some specimens, and ending in sharp angle, forming U-shaped fissure before supraorbital border. Supraorbital borders each with two large, slightly rounded to triangular lobes. Postorbital angles short (not extending beyond dorsal border of retracted eye), only

Source : MNHN, Paris

slightly pointed inward. Cornea of eyes dorsoventrally flattened, wider than base of short eye peduncle; each peduncle with three granular tubercles on distal border (most ventral tubercle conspicuous, protuberant).

Suborbital borders (Fig. 6b) each with one slightly rounded outer lobe; one slightly higher, narrower, obliquely-directed inner lobe; wide gap or notch at confluence of outer and inner lobes. Pterygostomial lobes project ventrally, forming flat, semicircular (sometimes notched), or pointed structure posterior to each inner suborbital lobe.

Each basal antennal segment thick, tuberculate, rectangular, slightly expanded distally; flagellum long, with few, simple setae. Epistome vertically inclined, with two broadly rounded (narrower, triangular in small specimens), short median teeth flanked on each side by very broad, curved margin connecting directly with pterygostomial lobe. Inner border of ischia of third maxillipeds straight; surface coarsely granular, upper borders obliquely cut. Meri much narrower than ischia; upper lobes straight with rounded outer borders.

Outer border of each cheliped propodus with one row of 1-5 thin, rounded tubercles. Fingers of largest cheliped with cutting edges (rounded teeth in small specimens), 3-5 rounded to triangular teeth in smallest cheliped (only sinuous edge in largest specimens). Carpi short, outer borders with low, rounded tubercles; meri slender, distal portions of outer borders with rounded or pointed tubercles.

First three pairs of walking legs (P2-4; Fig. 5c) flattened. Upper and lower borders of meri with tubercles of different sizes and shapes (some pointed, some rounded; smaller but on two anterior rows in P2); distalmost tubercle on each anterior border much wider at base, much higher, slender, pointed, directed distally (only rounded to triangular in P4). Anterior border of carpi of walking legs (P2-4) tuberculate; borders of propodi and dactyli (Fig. 6c) entire. Each P2 with one row of tubercles of dorsal, two rows on ventral surface of merus; two dorsal, two ventral carinae each on carpus and propodus; one dorsal, one ventral carinae on dactylus. Each P3 with one dorsal row of tubercles on merus; two dorsal, two ventral carinae each on carpus and propodus; one dorsal, 2-3 ventral carinae on dactylus. Each P4 with two dorsal rows of tubercles on merus; two dorsal, two ventral carinae each on carpus and propodus; one dorsal, 2-3 ventral carinae on dactylus. Meri of all walking legs with scattered to numerous plumose setae; dorsal surfaces of propodi and dactyli of P3-4 with one row of conspicuous plumose setae along anterior border.

First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair slightly shorter than second. Fifth pair of pereopods (P5) short (0.7-0.8 CL); each merus slender, surface with microscopic tubercles, many microscopic tubercles and 1-6 short spines along posterior border; each propodus with 4-7 spines along posterior border; each dactylus with 2-6 short, thick spines along posterior border (up to 7 spines along anterior border in some specimens), one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.1-1.2	2.0	1.9-2.0	0.7-0.8
Merus length/CL	0.3-0.4	0.6	0.5-0.6	0.2
Dactylus length/Cl	0.2-0.3	0.4-0.5	0.3-0.4	0.2

Abdomen of mature males with all segments free. One complete transverse ridge along each segment 1-4, and incomplete, low ridge along median portions of segments 5-6. Male first pleopods (Figs 6d-e) with sinuous basal parts; each distal part with two bilobed processes, inner one broad, longer and outer one (with gonopodal duct) narrow, shorter, and provided with minute teeth.

Abdomen of mature females with all segments free. One transversal ridge along each segment 1-4 (low ridge along segment 5 in most specimens).

DISCUSSION. — *P. declivis* is characterized by anterolateral teeth that decrease in size from first to fourth, and walking legs (P2-4) with entire, unarmed dactyli. The dactyli are also unarmed in *P. oahuensis* but they are not as long and slender as in *P. declivis*. *P. declivis* shares with *P. sexlobatus* (Kensley, 1969) anterolateral teeth that decrease in size and unarmed dactyli. All three species can be easily distinguished by examining their characteristic male first pleopods.

Source : MNHN, Paris

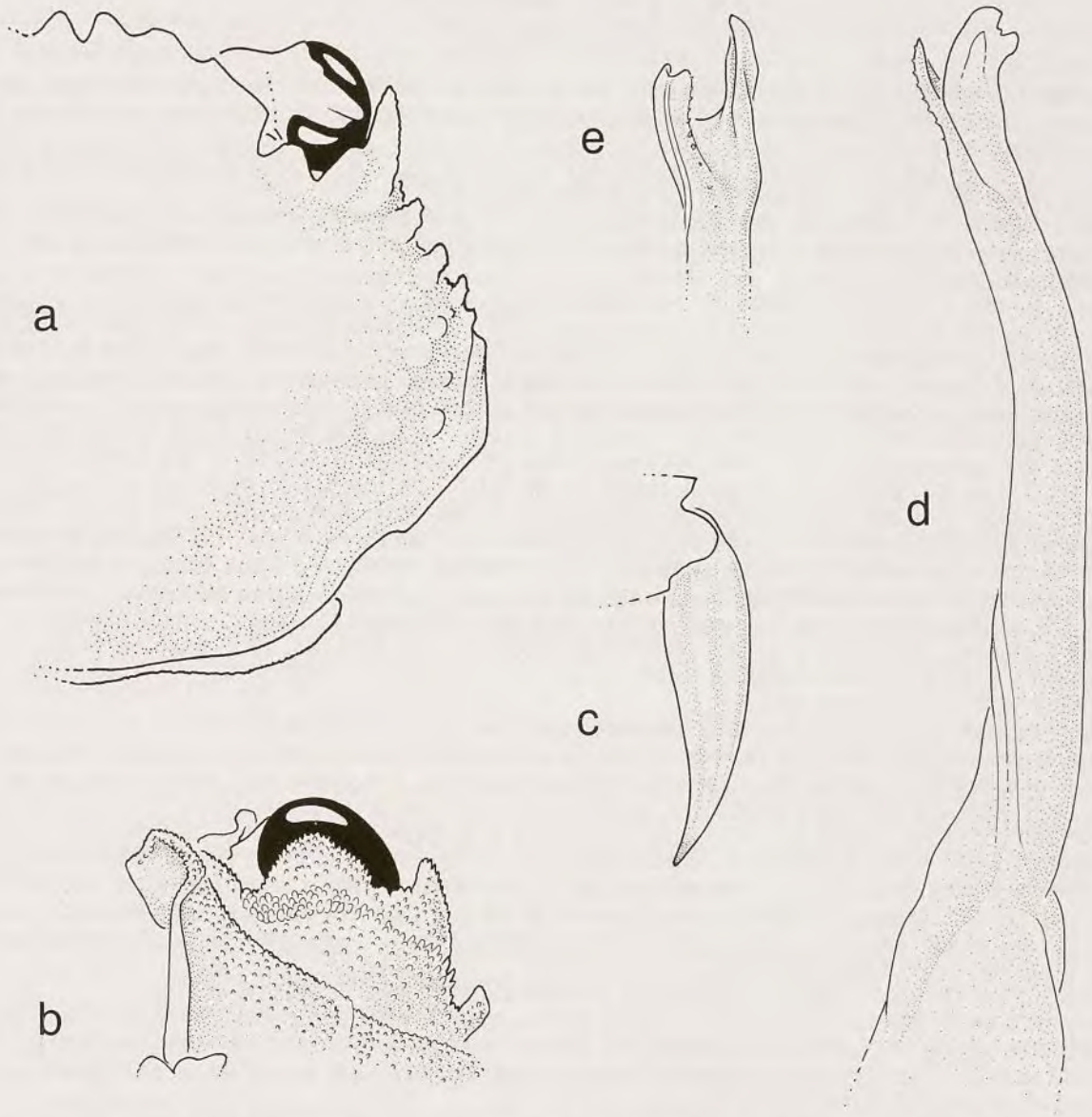


FIG. 6. — *Pseudopalicus declivis* sp. nov., ♂ holotype 11.1 x 13.4 mm, Norfolk Ridge, south of New Caledonia, BATHUS 3, stn DW 827, 381-469 m (MNHN-B 26677): **a**, carapace, dorsal surface; **b**, suborbital border; **c**, dactylus, right fourth pereopod, dorsal view; **d**, left male first pleopod, dorsal view; **e**, left male first pleopod, apex, ventral view.

SIZE. — Maximum size among specimens examined: 18.5 x 22.6 mm (female, MNHN-B 26740); 12.4 x 14.7 mm (male, MNHN-B 26741).

ETYMOLOGY. — From *declivis*, Latin for downhill, in reference to the decrease in size in a posterior, or downward, direction of the anterolateral teeth.

DISTRIBUTION. — Known from the South China Sea (off the Philippine Islands), Banda Sea (Indonesia), and the Coral Sea (Vanuatu, Chesterfield Islands, New Caledonia, and the Loyalty Islands) (Fig. 55). Depth: 189-469 m.

Source : MNHN, Paris

Pseudopalicus glaber sp. nov.

Figs 5d, 7, 55, 60b

MATERIAL EXAMINED. — **New Caledonia**. MUSORSTOM 4: stn DW 164, 18°33.2'S, 163°13.0'E, 255 m, 16.09.1985: 1 ♂ (MNHN-B 26991). — Stn DW 183, 19°01.8'S, 163°25.8'E, 280 m, 18.09.1985: 1 ♂ holotype 9.1 x 10.9 mm (MNHN-B 26683).

CHALCAL 2: stn DW 78, 23°41.3'S, 167°59.6'E, 233 m, 30.10.1986: 1 ♀ (MNHN-B 26985). — Stn DW 83, 23°20.3'S, 168°05.5'E, 200 m, 31.10.1986: 1 ♂, 1 ♀ (MNHN-B 26986).

SMIB 3: stn DW 14, 23°40'S, 168°00'E, 246 m, 22.05.1987: 1 ♂, 3 ♀ (MNHN-B 27028). — Stn DW 18, 23°41.5'S, 167°59.4'E, 338 m, 23.05.1987: 1 ♀ (MNHN-B 27016). — Stn DW 20, 23°40'S, 168°00'E, 280 m, 23.05.1987: 1 ♂, 1 ♀ (MNHN-B 27029).

SMIB 4: stn DW 57, 23°21.5'S, 168°04.6'E, 260 m, 9.03.1989: 1 ♀ 8.4 x 10.6 mm (MNHN-B 26812).

SMIB 5: stn DW 70, 23°40.6'S, 168°01.1'E, 270 m, 7.09.1989: 1 ♀ (MNHN-B 26980). — Stn DW 71, 23°41.3'S, 168°00.7'E, 265 m, 7.09.1989: 2 ♂, 2 ♀ (MNHN-B 27026). — Stn DW 72, 23°42.0'S, 168°00.8'E, 400 m, 7.09.1989: 1 ♀ (MNHN-B 27019). — Stn DW 73, 23°41.4'S, 168°00.6'E, 240 m, 7.09.1989: 1 ♀ paratype 11.7 x 15.0 mm (MNHN-B 26686). — Stn DW 74, 23°40.2'S, 168°00.9'E, 245 m, 7.09.1989: 1 ♀ (MNHN-B 26981). — Stn DW 75, 22°40.9'S, 168°00.8'E, 270 m, 7.09.1989: 6 ♀ (MNHN-B 27030). — Stn DW 76, 23°41.2'S, 168°00.5'E, 280 m, 7.09.1989: 1 ♂ paratype 11.0 x 13.5 mm (MNHN-B 26684), 2 ♀ (MNHN-B 26983). — Stn DW 77, 23°40.0'S, 168°01.1'E, 270 m, 7.09.1989: 2 ♀ (MNHN-B 27020). — Stn DW 78, 23°40.8'S, 168°00.2'E, 245 m, 7.09.1989: 1 ♀ (MNHN-B 26988). — Rocky bottom, no station number, 250 m, 13.09.1989: 1 ♂ paratype 7.7 x 9.0 mm (MNHN-B 26685), 2 ♀ (MNHN-B 26977). — Stn DW 85, 22°20.0'S, 168°42.9'E, 260 m, 13.09.1989: 1 ♀ (MNHN-B 26987). — Stn DW 88, 22°18.6'S, 168°40.2'E, 350 m, 13.09.1989: 1 ♀ (MNHN-B 27018). — Stn DW 91, 22°18.4'S, 168°41.1'E, 340 m, 13.09.1989: 1 ♀ (MNHN-B 26973). — Stn DW 101, 23°21.2'S, 168°04.9'E, 270 m, 14.09.1989: 4 ♀ (MNHN-B 27027), 1 ♂ paratype 7.1 x 8.4 mm, 1 ♀ paratype 8.5 x 10.8 mm (ZRC 1999.1429-1430). — Stn DW 102, 23°19.6'S, 168°04.7'E, 305 m, 14.09.1989: 1 ♂, 1 ♀ (MNHN-B 27007). — Stn DW 103, 23°17.4'S, 168°04.8'E, 315 m, 14.09.1989: 1 ♀ 9.8 x 12.3 mm (MNHN-B 26687). — Stn DW 105, 23°14.3'S, 168°04.5'E, 310 m, 14.09.1989: 1 ♀ (MNHN-B 27024).

BERYX 11: stn DW 40, 23°41'S, 168°01'E, 240-300 m, 20.10.1992: 2 ♀ (MNHN-B 27023).

SMIB 8: stn DW 155, 24°45.7'S, 168°08.2'E, 257-262 m, 28.01.1993: 1 ♀ (MNHN-B 26978). — Stn DW 163, 24°49.1'S, 168°08.9'E, 310-460 m, 28.01.1993: 2 ♂ (MNHN-B 26984). — Stn DW 170, 23°41.2'S, 168°00.5'E, 241-244 m, 29.01.1993: 4 ♀ (MNHN-B 27011), 1 ♂ paratype 11.4 x 14.0 mm, 1 ♀ paratype 10.6 x 13.4 mm (USNM). — Stn DW 181, 23°17.7'S, 168°04.8'E, 311-330 m, 31.01.1993: 2 ♀ (MNHN-B 26975). — Stn DW 182, 23°19.3'S, 168°04.8'E, 314-340 m, 31.01.1993: 2 ♂ (MNHN-B 27015). — Stn DW 183, 23°18.3'S, 168°04.9'E, 330-367 m, 31.01.1993: 1 ♀ (MNHN-B 27021). — Stn DW 184, 23°18.3'S, 168°04.8'E, 305-320 m, 31.01.1993: 1 ♂ (MNHN-B 26974). — Stn 185, 23°16'S, 168°04.3'E, 305-355 m, 31.01.1993: 1 ♂, 1 ♀ (MNHN-B 26989). — Stn DW 187, 23°17.7'S, 168°05.6'E, 390-540 m, 31.01.1993: 1 ♀ (MNHN-B 27014). — Stn 190, 23°18.5'S, 168°04.9'E, 305-310 m, 31.01.1993: 2 ♂ (MNHN-B 27022).

BATHUS 2: stn DW 727, 22°48.03'S, 167°29.03'E, 299-302 m, 12.05.1993: 1 ♀ (MNHN-B 27013).

BATHUS 3: stn CP 804, 23°41'S, 168°00'E, 244-278 m, 27.11.1993: 1 ♀ (MNHN-B 26979). — Stn CP 805, 23°41'S, 168°01'E, 278-310 m, 27.11.1993: 6 ♀ (MNHN-B 27009). — Stn DW 829, 23°21'S, 168°02'E, 386-390 m, detritic rubble, 29.11.1993: 3 ♂, 2 ♀ (MNHN-B 26742). — Stn DW 830, 23°20'S, 168°01'E, 361-365 m, 29.11.1993: 1 ♂, 1 ♂ feminized by sacculinid, 6 ♀ (MNHN-B 27008).

BATHUS 4: stn DW 924, 18°54.85'S, 163°24.34'E, 344-360 m, 7.08.1994: 2 ♂ (MNHN-B 26982). — Stn DW 925, 18°54.55'S, 163°23.75'E, 370-405 m, 7.08.1994: 4 ♀ (MNHN-B 27025). — Stn DW 926, 18°56'S, 163°25'E, 325-330 m, 7.08.1994: 1 ♂, 1 ♀ (MNHN-B 27010). — Stn DW 931, 18°55.38'S, 163°24.36'E, 360-377 m, 7.08.1994: 2 ♀ (MNHN-B 26972). — Stn CP 936, 19°03.67'S, 163°28.05'E, 258-252 m, 8.08.1994: 1 ♀ paratype 16.5 x 20.4 mm (MNHN-B 26688).

HALICAL 1: stn DW 1, 18°54.95'S, 163°24'E, 380-400 m, 23.11.1994: 1 ♀ (MNHN-B 26990). — Stn DW 2, 18°55.86'S, 163°24.18'E, 252-397 m, 23.11.1994: 1 ♀ (MNHN-B 27012). — Stn DW 4, 18°55'S, 163°23.29'E, 350-365 m, 29.11.1994: 1 ♂, 1 ♀ (MNHN-B 26976).

Gemini Seamounts. VOLSMAR: stn DW 51, 20°58.5'S, 170°03.4'E, 450 m, 4.07.1989: 1 ♀ (MNHN-B 27017).

TYPES. — *Holotype*: 1 ♂ 9.1 x 10.9 mm, MUSORSTOM 4, stn DW 183 (MNHN-B 26683).

Paratypes: 1 ♂ 11.0 x 13.5 mm, SMIB 5, stn 76 (MNHN-B 26684); 1 ♂ 7.7 x 9.0 mm, SMIB 5, no station number (MNHN-B 26685); 1 ♀ 11.7 x 15.0 mm SMIB 5, stn 73 (MNHN-B 26686); 1 ♀ 9.8 x 12.3 mm, SMIB 5, stn DW 103 (MNHN-B 26687); 1 ♀ 16.5 x 20.4 mm, BATHUS 4, stn CP 936 (MNHN-B 26688); 1 ♂ 11.4 x 14.0 mm, 1 ♀ 10.6 x 13.4 mm, SMIB 8, stn DW 170 (USNM); 1 ♂ 7.1 x 8.4 mm, 1 ♀ 8.5 x 10.8 mm, SMIB 5, stn DW 101 (ZRC 1999.1429-1430).

Source : MNHN, Paris

TYPE LOCALITY. — Grand Passage, north of New Caledonia, 19°01.8'S, 163°25.8'E, 280 m.

DIAGNOSIS. — Carapace (Figs 5d, 7a, 60b) with four pointed anterolateral teeth on each side; first three teeth almost equal in size, larger than very small last tooth. Dorsal surface of carapace with few, mostly low, granular bosses, leaving posterior third of carapace relatively smooth. Supraorbital borders each with two rounded lobes. Suborbital borders (Fig. 7b) each with two broad, slightly rounded lobes, Dorsal borders of cheliped propodi each with one row of thin, rounded tubercles. Dactyli of walking legs (P2-4) with short spines along posterior borders (3-5 spines in P4; Fig. 7c). Abdomen of mature males with all segments free, one complete transverse ridge along each segment 1-3, incomplete ridge along each median portions of segments 4-6. Male first pleopods (Figs 7d-f) with sinuous basal parts; each distal part with pointed, spinous dorsal tip, ventral process with two superimposed foliaceous portions. Abdomen of mature females with segments free, one complete transverse ridge along each segment 1-4 (low ridge may be present along segment 5).

Color: A female from New Caledonia photographed live (Fig. 60b) had a white vertical band through the center of the carapace. A brown spot was located on each area anterior and posterior of the white band. The rest of the carapace was light green and light brown, with small blue spots throughout the branchial regions. The walking legs were light green with light brown bands.

DESCRIPTION. — Carapace (Figs 5d, 7a, 60b) transversely hexagonal, wider than long (CW/CL = 1.2-1.3); dorsal surface covered with small granules and few, mostly low, granular bosses (most conspicuous bosses 3-4 on branchial region, particularly very large specimens), leaving posterior third of carapace relatively smooth. Anterolateral borders of carapace each with four pointed teeth, first three of which almost equal in size (first slightly larger, rounder in many specimens) and larger than very small last tooth (differences more apparent in larger specimens). Posterior border with an evenly raised edge, no separate tubercles (except in very small specimens), scattered plumose setae.

Frontal border of carapace divided into four narrow, rounded lobes (inner lobes narrower, longer, and very close to each other; outer lobes may be broad in some specimens). Borders between frontal lobes and supraorbital borders straight, folded upward, slightly pointed to conspicuously pointed anteriorly (giving anterior border six-lobed appearance in largest specimens), ending in sharp angle, forming V-shaped fissure before supraorbital border. Supraorbital borders each with two rounded lobes. Postorbital angles moderately long (extend almost to dorsal border of retracted eye), slender, slightly pointed inward. Cornea of eyes dorsoventrally flattened, wider than base of short eye peduncle; each peduncle with one conspicuous, granular tubercle on distal border.

Suborbital borders (Fig. 7b) each with broad, rectangular outer lobe, similar in shape (but slightly rounded in larger specimens); slightly higher, inner lobe. Pterygostomial lobes project ventrally, forming flat, semicircular structure posterior to each inner suborbital lobe.

Each basal antennal segment thick, rectangular, rounded distal margin; flagellum long, with few, simple setae. Epistome vertically inclined, with two triangular, pointed (short, rounded in small specimens) median teeth, each flanked by triangular outer process and thin, rounded margin before pterygostomial lobe. Inner border of ischia of third maxillipeds straight; surface coarsely granular, upper borders rounded. Meri much narrower than ischia; anterior upper lobes much reduced, with rounded outer borders.

Outer surfaces of cheliped propodi each with one row of 1-4 thin, rounded tubercles. Fingers of largest cheliped with cutting edges (broadly rounded teeth in some specimens), 2-7 rounded to triangular teeth in smallest cheliped (only sinuous edge in largest specimens). Carpi short, outer borders with one thin, broadly rounded or triangular tubercle and several low, rounded tubercles; merus slender, distal portions of outer borders with low, rounded tubercles.

First three pairs of walking legs (P2-4; Figs 5d, 60b) flattened. Upper borders of meri with mostly large, triangular tubercles; lower borders with few, low tubercles; distalmost tubercle on each anterior border much wider at base, much higher, slender, pointed, directed distally (only rounded to triangular in P4). Anterior border of carpi of walking legs (P2-4) each with two large, triangular tubercles; borders of propodi entire. Each P2 with one dorsal, 1-2 ventral rows of tubercles on merus; one dorsal, one ventral carinae on carpus; one dorsal carina on propodus; two dorsal, 1-2 ventral carinae, 4-5 short, thick spines on dactylus. Each P3 with one dorsal, two ventral rows of tubercles on merus (very low in some specimens); two dorsal, one ventral carinae on carpus; two dorsal,

Source : MNHN, Paris

two ventral carinae on propodus; two dorsal, 2-3 ventral carinae, 3-4 short, thick spines on dactylus. Each P4 with 1-2 dorsal rows of tubercles on merus (very low in some specimens); two dorsal, one ventral carinae on carpus; two dorsal, two ventral carinae on propodus; one dorsal, 2-3 ventral carinae, 3-5 short, thick spines on dactylus (Fig. 7c). Meri of all walking legs with scattered plumose setae; dorsal surfaces of propodi and dactyli of P3-4 each with one row of conspicuous plumose setae along anterior border.

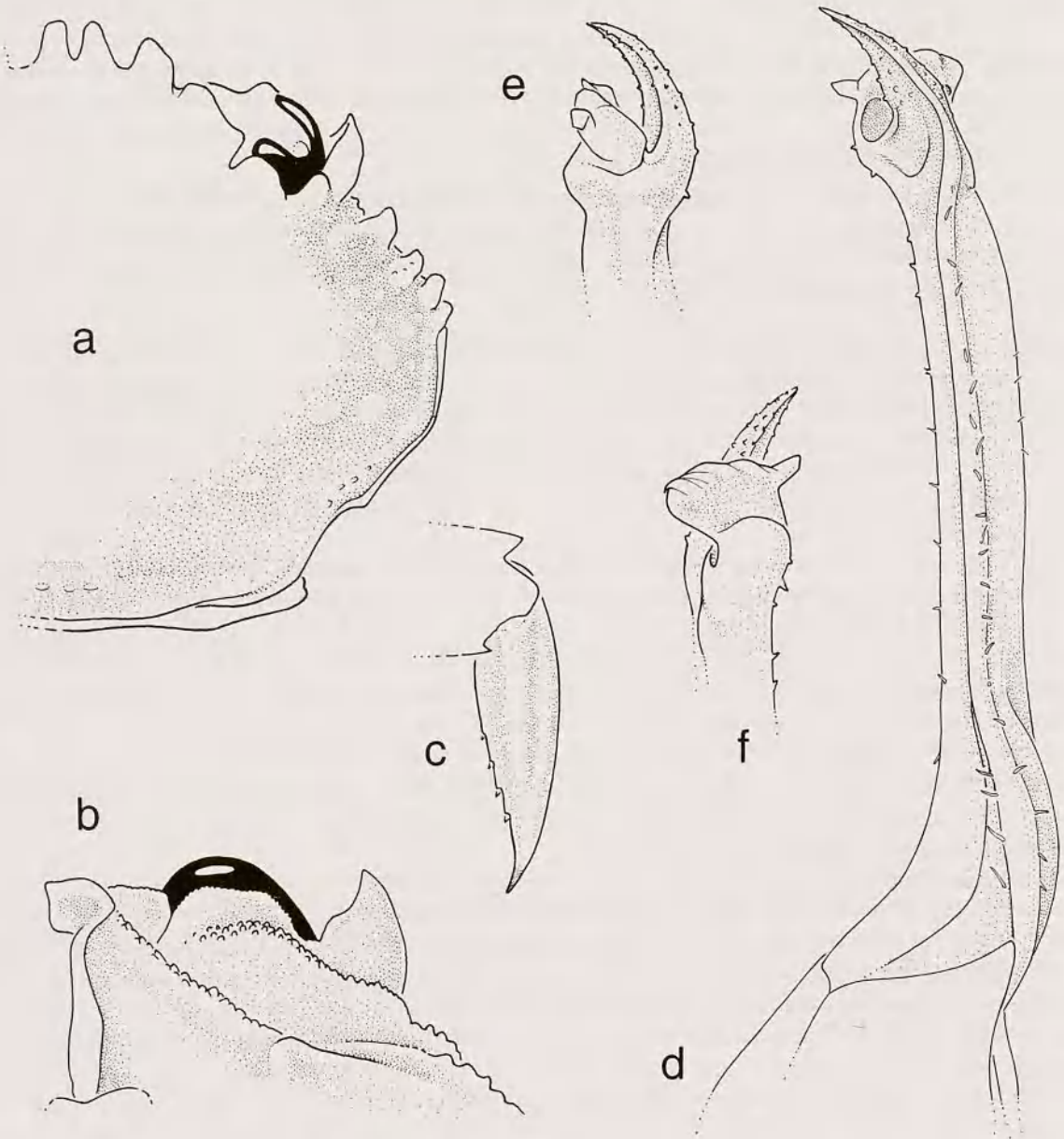


FIG. 7. — *Pseudopalicus glaber* sp. nov., ♂ paratype 7.7 x 9.0 mm, Norfolk Ridge, south of New Caledonia, SMIB 5, unknown station, 250 m (MNHN-B 26685): **a**, carapace, dorsal surface; **b**, suborbital border; **c**, dactylus, right fourth pereopod, dorsal view; **d**, left male first pleopod, dorsal view; **e**, left male first pleopod, apex, lateral (outer side) view; **f**, left male first pleopod, apex, ventral view.

First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair slightly shorter than second. Fifth pair of pereopods (P5) short (0.8 CL); each merus slender, surface with microscopic

Source : MNHN, Paris

tubercles, many microscopic tubercles, plumose setae along posterior border; each propodus with 4-6 spines along posterior border; each dactylus with 3-8 short, thick spines along posterior border (mostly along distal portion), 5-10 short spines along anterior border, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.0-1.1	1.7-2.1	1.6-2.0	0.8
Merus length/CL	0.3-0.4	0.5-0.6	0.5-0.6	0.2-0.3
Dactylus length/Cl	0.2	0.3-0.4	0.3-0.4	0.2

Abdomen of mature males with all segments free. One complete transverse ridge along each segment 1-3, and incomplete ridge along each median portions of segments 4-5 (low, incomplete ridge in segment 6 in some specimens). Male first pleopods (Figs 7d-f) with sinuous basal parts; each distal part with pointed, spinous dorsal tip and ventral process with two superimposed foliaceous portions.

Abdomen of mature females with all segments free. One transversal ridge along each segment 1-4 (low ridge may be present along segment 5).

DISCUSSION. — *P. glaber* is easily distinguished from other species of *Pseudopalicus* by the smooth appearance of the posterior third of the carapace. Only a few small specimens showed low tubercles along the posterior border of the carapace.

SIZE. — Maximum size among specimens examined: 16.5 x 20.4 mm (female paratype, MNHN-B 26688); 11.0 x 12.8 mm (male, MNHN-B 26742).

ETYMOLOGY. — From *glaber*, Latin for smooth, in reference to the relatively smooth dorsal surface, particularly the posterior portion, of the carapace.

DISTRIBUTION. — Known from New Caledonia (including the Norfolk Ridge south of New Caledonia) and the Gemini Seamounts east of New Caledonia (Fig. 55). Depth: known reliably between 200 and 450 m; also collected in a trawl between 390 and 540 m.

Pseudopalicus oahuensis (Rathbun, 1906)

Figs 4e-f, 12a, 54, 60c

Palicus oahuensis Rathbun, 1906: 836, fig. 2, pl. 7, fig. 4. — EDMONDSON, 1933: 268; 1946: 309. — MCNEILL, 1968: 81, pl. 2, figs 5-6.
Cymopolia oahuensis - EDMONDSON, 1962: 9.
Pseudopalicus oahuensis - MOOSA & SERÈNE, 1981: 37 (in key).
non *Palicus oahuensis* - BALSS, 1922: 120, fig. 6. — YOKOYA, 1933: 206, 212 [= *Pseudopalicus amadaibai* (Sakai, 1963)].
non *Cymopolia oahuensis* - SAKAI, 1939: 609, fig. 90a; 1956: 52. — NAKAZAWA & SAKAI, 1947: 665, unnumb. fig. [= *Pseudopalicus amadaibai* (Sakai, 1963)].

MATERIAL EXAMINED. — **Taiwan**. *Tai-Shi*. M.-S. JENG coll., 29.04.1998: 1 ♀ (ASIZT 72007).
Indonesia. *Kai Islands*. KARUBAR: stn CP 17, 05°15'S, 133°01'E, 459-439 m, 24.10.1991: 1 ♂ (MNHN-B 26925).
Australia. GREAT BARRIER REEF EXPEDITION: stn 15, Cook's Passage, east of Lookout Point, 384 m, 8.03.1929: 1 ♀ (BMNH 1950.12.1.23).
Chesterfield Islands. MUSORSTOM 5: stn DW 306, 22°07.66'S, 159°21.40'E, 375-415 m, 12.10.1986: 2 ♀ (MNHN-B 26931).
New Caledonia. BIOCAL: stn CP 67, 24°55'S, 168°22'E, 500-510 m, 3.09.1985: 1 ♀ (MNHN-B 26928).
MUSORSTOM 4: stn CP 194, 18°52.8'S, 163°21.7'E, 545 m, 19.09.1985: 1 ♀ (MNHN-B 26929). — Stn CP 195, 18°54.8'S, 163°22.2'E, 465 m, 19.09.1985: 2 ♂, 5 ♀ (MNHN-B 26923), 1 ♂ 10.6 x 16.9 mm (MNHN-B 26744). — Stn CP 238, 22°13.0'S, 167°14.0'E, 500-510 m, 2.10.1985: 1 ♀ 11.7 x 15.8 mm (MNHN-B 26930).

Source : MNHN, Paris

CHALCAL 2: stn DW 73, 24°39.9'S, 168°38.1'E, 573 m, 29.10.1986: 1 juv. ♂, 1 ♂, 2 ♀ (MNHN-B 26932). — Stn DW 74, 24°40.36'S, 168°38.38'E, 650 m, 29.10.1986: 1 ♀ (MNHN-B 26933). — Stn DW 75, 24°39.31'S, 168°39'67'E, 600 m, 29.10.1986: 1 ♀ 8.2 x 10.7 mm (MNHN-B 26813).

SMIB 4: stn DW 56, 23°20.6'S, 168°05.2'E, 260 m, 9.03.1989: 1 ♂ 7.8 x 10.4 mm (MNHN-B 26806).

BERYX 11: stn CP 7, 24°55'S, 168°21'E, 510-550 m, 15.10.1992: 1 ♀ (MNHN-B 26934). — Stn DW 9, 24°52'S, 168°22'E, 635-680 m, 15.10.1992: 2 ♀ (MNHN-B 26935).

SMIB 8: stn DW 146, 24°55.2'S, 168°21.7'E, 514-522 m, 27.01.1993: 1 ♀ (MNHN-B 26936). — Stn DW 149, 24°54.9'S, 168°21.8'E, 508-510 m, 27.01.1993: 1 ♂ (MNHN-B 26937). — Stn DW 150, 24°54.3'S, 168°22.2'E, 519-530 m, 27.01.1993: 1 ♀ (MNHN-B 26938), 2 ♂ (MNHN-B 26743).

BATHUS 4: stn DW 927, 18°55.48'S, 163°22.11'E, 452-444 m, 7.08.1994: 1 ♀ (MNHN-B 26924).

Loyalty Islands. *"Vauban"* DREDGINGS 1977: 20°30'S, 166°48'E, 375 m, 22.02.1977: 1 ♂ (MNHN-B 26992).

Loyalty Ridge. BATHUS 3: stn DW 798, 23°35'S, 169°37'E, 657-660 m, rocks, 26.11.1993: 1 ♀ (MNHN-B 26993). — Stn DW 800, 23°35'S, 169°37'E, 655 m, rocks and gravel, 26.11.1993: 1 ♀ (MNHN-B 26994).

Vanuatu. MUSORSTOM 8: stn CP 983, 19°21.61'S, 169°27.76'E, 480-475 m, 23.09.1994: 3 ♂ (MNHN-B 26926). — Stn CP 1026, 17°30.35'S, 168°39.33'E, 437-504 m, 28.09.1994: 1 ♂ (MNHN-B 26927).

French Polynesia. SMCB (J. POUPIN coll.). *Society Islands. Maupiti Island*: stn D 92, 16°28.40'S, 151°14.00'E, 397 m, 12.05.1991: 1 ♀ (MNHN-B 26273).

Tubai Islands: stn 350, 23°20.7'S, 147°32.4'W, 350-200 m, 5.12.1990: 1 ♀ (MNHN-B 26274).

Hawaiian Islands. *"Albatross"*: stn 3919, Oahu, off south coast, 470-402 m, : 1 ♀ holotype of *Palicus oahuensis* Rathbun, 1906 7.2 x 10.0 mm (USNM 29374).

TYPES. — *Holotype* of *Palicus oahuensis* Rathbun, 1906: 1 ♀ 7.2 x 10.0 mm, *"Albatross"*, stn 3919 (USNM 29374).

TYPE LOCALITY. — Off south coast, Oahu, Hawaiian Islands, 470-402 m.

DIAGNOSIS. — Carapace (Figs 12a, 60c) with four anterolateral teeth on each side; first tooth rounded, blunt, followed by two larger, pointed teeth (second usually slightly larger that third) and one very small last tooth. Dorsal surface of carapace with large, granular bosses, 10 of which form an almost straight row across branchial and metagastric regions in large specimens; posterior border with four salient, elongate tubercles, 4-6 smaller, anterior tubercles in large specimens. Supraorbital borders each with two short, straight-edged lobes. Suborbital borders each with two broad, rounded lobes; inner slightly higher. Anterior borders of cheliped propodi with rounded tubercles of various sizes. Anterior and posterior borders of meri of walking legs (P2-4) with thin, nearly equal, dentiform tubercles (Figs 12a, 60c). Dactyli of walking legs (P4) with posterior border entire. Abdomen of mature males with all segments free, sutures between segments 4-5 and 3-4 with median U-shaped constriction, one complete transverse ridge along each segment 1-3, incomplete ridge on segment 4. Male first pleopods (Figs 4e-f) with sinuous basal parts; each distal part broad, flattened, pointed ventrally, two small ventral processes at base. Abdomen of mature females with all segments free, one complete transverse ridge along each segment 1-4 (low ridge may be present along segment 5).

Color: Both the carapace and walking legs of a female from New Caledonia photographed live (Fig. 60c) were pink and light blue. Most tubercles on the dorsal surface of the carapace were light orange.

DISCUSSION. — In addition to the male first pleopods, diagnostic for *P. oahuensis* is a first anterolateral tooth that is short and rounded in contrast to the more prominent and pointed second and third teeth. The meri of the walking legs (P2-4) are prominent and have nearly equal, dentiform tubercles along both the anterior and posterior borders that give the legs a frilly, almost lace-like appearance (Figs 12a, 60c; MCNEILL, 1968, pl. 2, fig. 5).

Other characters of *P. oahuensis* include a carapace with a frontal border that is divided into a pair of narrow and pointed inner lobes, and broad and rounded outer lobes (but narrow and pointed in some small specimens). The frontal lobes are followed by a folded-upward and rounded border before the supraorbital border. The postorbital angles are short (not extending beyond the dorsal border of the retracted eye) and blunt. Each basal antennal segment is slender, rectangular, and tuberculate on its ventral surface. Each eye peduncle has two granular tubercles on the distal border. The pterygostomial lobes project ventrally, forming a flat, semicircular structure posterior to each inner suborbital lobe. The epistome is vertically inclined, with two broadly rounded median teeth flanked on

Source : MNHN, Paris

each side by a triangular outer process and a thin, rounded margin before joining the anterior process of the buccal frame. The third pair of walking legs (P4) has relatively slender meri (0.5-0.6 CL), pointed teeth all along both borders, and one blunt distal tooth on each anterior border. The fifth pair of pereopods (P5) is short (0.7-0.8 CL), each merus and propodus has numerous pointed tubercles along the posterior border, and each dactylus with 5-12 short spines along the posterior border and two thick distal spines in addition to the terminal tooth.

SIZE. — Maximum size among specimens examined: 12.7 x 17.3 mm (female, MNHN-B 26743); 10.6 x 16.9 mm (male, MNHN-B 26744).

DISTRIBUTION. — This species has a relatively wide distribution throughout the Pacific basin (Fig. 54). It has been recorded from the Hawaiian Islands (RATHBUN, 1906; EDMONDSON, 1933, 1946, 1962) and the Great Barrier Reef, Queensland, Australia (MCNEILL, 1968). It is now also known from Taiwan, Banda Sea (Indonesia), Coral Sea (Vanuatu, New Caledonia, and the Loyalty Islands), and French Polynesia. A record of a specimen from a shallow-water reef in the Hawaiian Islands (EDMONDSON, 1930: 17; 1962: 9) is most probably a misidentification. Depth: known reliably between 260 and 660 m; also collected in trawls between 200-350 and 635-680 m.

Pseudopalicus sexlobatus (Kensley, 1969)

Fig. 52

Palicus sexlobatus Kensley, 1969: 156, fig. 2a-e; 1981: 50.
Pseudopalicus sexlobatus - MOOSA & SERÈNE, 1981: 37 (in key).

MATERIAL EXAMINED. — **Mozambique Channel**. *"Anton Bruun"*: stn 371F, 24°46'S, 35°18'E, rock dredge, 110 m, 18.08.1964: 1 ♂ holotype of *Palicus sexlobatus* Kensley, 1969 8.2 x 9.7 mm (SAM A 12642).
Mauritius. Tombeau Bay, stn 43, 238 m, T. MORTENSEN coll., 11.10.1929: 1 ♀ 12.5 x 15.8 mm (ZMUC).

TYPES. — *Holotype* of *Palicus sexlobatus* Kensley, 1969: 1 ♂ 8.2 x 9.7 mm (SAM A 12642).

TYPE LOCALITY. — Mozambique Channel, 24°46'S, 35°18'E, 110 m.

DIAGNOSIS. — Carapace (KENSLEY, 1969, fig. 2a) with four pointed anterolateral teeth on each side; teeth decrease in size posteriorly. Dorsal surface of carapace with relatively low, granular bosses; posterior border with six low, elongate tubercles. Supraorbital borders each with two triangular, pointed lobes. Suborbital borders (KENSLEY, 1969, fig. 2b) each with one broad outer lobe and one rectangular inner lobe. Dorsal borders of cheliped propodi (KENSLEY, 1969, fig. 2c) with pointed tubercles. Dactyli of walking legs (P2-4) with posterior border entire (KENSLEY, 1969, fig. 2e). Abdomen of mature males and females unknown. Male first pleopods (KENSLEY, 1969, fig. 2d) with sinuous basal parts; each distal part uniramous, with triangular teeth along inner and outer borders and square tip. Abdomen of mature females with all segments free, one complete transverse ridge along each segment 1-4.

DISCUSSION. — The holotype and an adult female are the only specimens examined. Other characters include a frontal border that is divided into two pointed inner and two rounded outer lobes, followed by a border that is slightly pointed near the middle before the supraorbital border. The postorbital angles are relatively long (they extend to the dorsal border of the retracted eye) and pointed. The walking legs (P2-4) have slender meri, each armed with one row of teeth along the anterior upper border and one large, pointed distal tubercle.

SIZE. — Size of the only two specimens examined: 12.5 x 15.8 mm (female, ZMUC); 8.2 x 9.7 mm (holotype male, SAM A 12642).

DISTRIBUTION. — Known only from the Mozambique Channel (KENSLEY, 1969) and Mauritius (Fig. 52). Depth: 110-238 m.

Source : MNHN, Paris

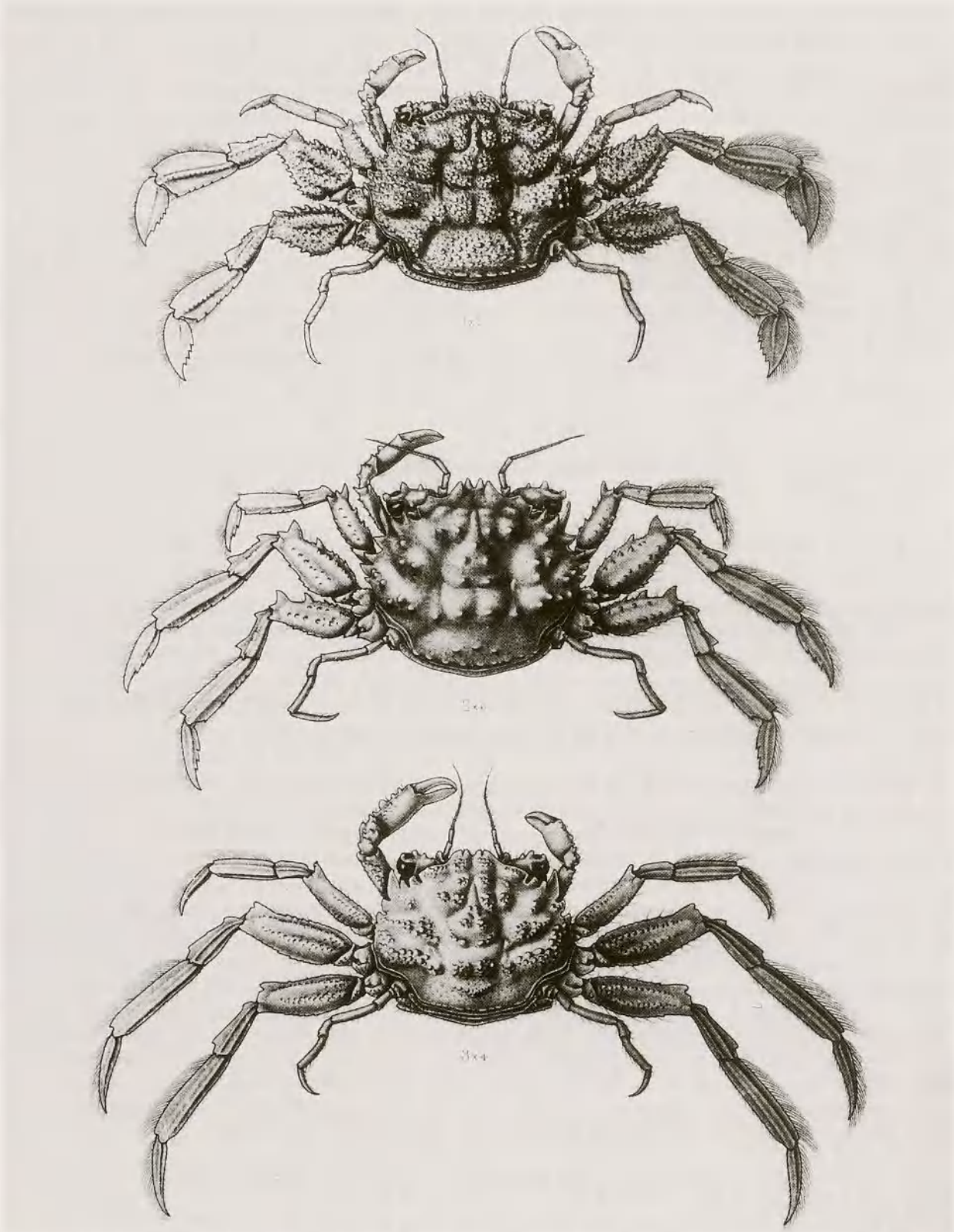


FIG. 8. — **a**, *Pseudopalicus serripes* (Alcock & Anderson, 1895). — **b**, *Pseudopalicus investigatoris* (Alcock, 1900). — **c**, *Rectopalicus woodmasoni* (Alcock, 1900). Plate 67 from ALCOCK & MCARDLE, 1903.

Source : MNHN, Paris

Pseudopalicus investigatoris (Alcock, 1900)

Figs 4b-c, 8b, 9a, 12b, 52, 60d

Palicus investigatoris Alcock, 1900: 455. — Alcock & McArdle, 1903: pl. 67, fig. 2.
Cymopolia fisheri Rathbun, 1906: 835, fig. 1, pl. 7, fig. 5.
Palicus fisheri - Edmondson, 1933: 268; 1946: 310.
Cymopolia cyrenae Ward, 1942a: 46, pl. 4, figs 1-2; 1942b: 53. — Michel, 1964: 33; 1974: 134. — Guinot, 1967: 280.
Pseudopalicus fisheri - Moosa & Serène, 1981: 36 (in key).
Pseudopalicus cyrenae - Moosa & Serène, 1981: 36 (in key).
Pseudopalicus investigatoris - Moosa & Serène, 1981: 36 (in key).
non *Palicus investigatoris* - MacGilchrist, 1905: 265 [= *Pseudopalicus serripes* (Alcock & Anderson, 1895)].

Material examined. — **Madagascar**. *Off Nosy Be. "Vauban"*: stn 52, trawl, 15°21.0'S, 46°12.5'E, 150 m, A. Crosnier coll., 8.11.1972: 1 juv. ♂ (MNHN-B 26910).

Mauritius. Tombeau Bay, stn 34, 366 m, T. Mortensen coll., 26.09.1929: 1 ♀ (ZMUC).

Western Australia. *"Diamantina"*: stn 33, west of Garden Island, 32°15.7'S, 115°06.7'E, 176-182 m, 18.03.1972: 1 ♀ (WAM C.23578). — Stn 56, west of Dongara, 29°18'S, 114°04'E, 170-174 m, 20.03.1992: 1 ♀ (WAM C.23571). — Stn 66, northwest of Green Head, 29°59'S, 114°25'E, 146 m, 22.03.1972: 1 ♀ (WAM C.23569).

Japan ?. No location: 1 ♂ 18.7 x 24.4 mm (SMF 24707).

Philippine Islands. Musorstom 1: stn 57, 13°53.1'N, 120°13.2'E, 107-96 m, 26.03.1976: 1 ♂ 10.3 x 12.0 mm (MNHN-B 26905).

Landsdowne-Fairway Banks. Chalcal 1: stn D 3, 120-150 m, 21°14.00'S, 162°16.40'E, 18.05.1984: 1 ♀ (MNHN-B 26915).

New Caledonia. Biocal: stn CP 84, 20°43'S, 167°01'E, 150-210 m, 6.09.1985: 1 ♀ 22.3 x 26.3 mm (MNHN-B 26745).

Lagon: stn 116, 43 m, sand and gravel, 22°25.2'S, 166°43.7'E, 08.1984: 1 ♀ (MNHN-B 26916). — Stn 390, 155 m, stylasterids and boulders, 22°42.6'S, 167°01.6'E, 22.01.1985: 1 ♀ (MNHN-B 26917).

Musorstom 4: stn DW 183, 280 m, 19°01.8'S, 163°25.8'E, 18.09.1985: 1 ♂ (MNHN-B 26918).

Smib 5: stn DW 95, 200 m, 22°59.7'S, 169°19.8'E, 14.09.1989: 1 ♀ (MNHN-B 26919).

Bathus 4: stn CP 938, 280-288 m, 19°00.16'S, 163°26.45'E, 8.08.1994: 1 ♀ (MNHN-B 26920). — Stn DW 942, 270-264 m, 19°04.26'S, 163°27.36'E, 8.08.1994: 3 ♀ (MNHN-B 26921).

Vanuatu. Musorstom 8: stn CP 1077, 180-210 m, 16°04.00'S, 167°06.09'E, 5.10.1994: 1 ♂ (MNHN-B 26911), 1 ♀ 11.7 x 14.5 mm (MNHN-B 26746), 1 ♀ (MNHN-B 26912). — Stn CP 1078, 194-230 m, 16°03.65'S, 167°26.18'E, 5.10.1994: 1 ♀ (MNHN-B 26913). — Stn CP 1086, 182-215 m, 15°36.58'S, 167°16.32'E, 5.10.1994: 1 ♀ 8.8 x 10.1 mm (MNHN-B 26747), 1 ♀ (MNHN-B 26914).

Fiji. Musorstom 10: stn 1323, 17°16.10'S, 177°45.75'E, 143-173 m, 7.08.1998: 1 juv. ♂ (MNHN-B 26922). — Stn. 1324, 17°17.37'S, 177°47.05'E, 102-104 m, 7.08.1998: 1 ♀ 8.2 x 9.5 mm (MNHN-B 26748).

Hawaiian Islands. *Kauai. "Albatross"*: stn 3987, 73-426 m: 1 ♂ holotype of *Cymopolia fisheri* Rathbun, 1906, 11.9 x 14.0 mm (USNM 29368).

Oahu. 30-300 m, M. King coll., 1959: 1 ♀ (LACM).

Types. — *Holotype* of *Palicus investigatoris* Alcock, 1900: 1 ♂ 7 x 8 mm, Andaman Islands, India (Alcock, 1900). Deposit unknown: Zoological Survey of India, Calcutta ?

Holotype of *Cymopolia fisheri* Rathbun, 1906: 1 ♂ 11.9 x 14.0 mm, off Kauai, Hawaiian Islands, 73-426 m (USNM 29368).

Holotype of *Cymopolia cyrenae* Ward, 1942: 1 ♀ CW 15 mm (Ward, 1942), Mauritius. Deposit unknown: Mauritius Institute, Port Louis, Mauritius ?

Type Locality. — Andaman Islands, India, unknown depth.

Diagnosis. — Carapace (Figs 8b, 12b, 60d; Alcock & McArdle, 1903, pl. 67, fig. 2) with four pointed anterolateral teeth on each side; first three teeth usually of similar size but always much larger than fourth (second and third teeth may be fused into wider tooth in smaller specimens). Dorsal surface of carapace with large granular bosses, 10 of which form an almost straight row across branchial and metagastric regions in large specimens; posterior border with 8-10 pointed or elongate tubercles. Supraorbital borders each with two triangular, pointed lobes. Suborbital borders (Fig. 9a) each with one broad, rounded outer lobe; long, pointed tooth on inner portion.

Source : MNHN, Paris

Typically two (sometimes one), sharply pointed teeth on pterygostomial ridge connecting pterygostomial lobe with pterygostomial region of carapace (Fig. 9a). Dorsal borders of cheliped propodi each with several rounded or pointed tubercles, at least one sharp tooth on proximal portion; inner surface of propodi of males smooth, without dense cluster of plumose setae; sharp teeth on dorsal surfaces of carpi and meri. Propodi and dactyli of walking legs (P3-4) with teeth along anterior borders. Dactyli of walking legs slender (P4 0.5-0.6 CL), with large teeth along posterior borders (2-3 teeth in P4; Figs 8b, 12b). Abdomen of mature males with all segments free, one complete but low ridge along segment 3. Male first pleopods (Figs 4b-c) with sinuous basal parts; simple distal part with small teeth along inner border. Abdomen of mature females with all segments free, one complete transverse ridge along each segment 1-4 (low ridge may be present along segment 5).

Color: A large female (11.7 x 14.5 mm; MNHN-B 26746) from Vanuatu photographed live (Fig. 60d) had a multicolored but mostly red-brown carapace and dark green depressed areas at the confluence of the branchial and mesogastric regions. A small immature female (8.8 x 10.1 mm; MNHN-B 26747) from the same region was light brownish yellow with bright orange depressed areas. An almost identical color pattern, light brownish yellow with bright orange depressed areas, was recorded in a female from Fiji that had been preserved for only nine months [8.2 x 9.5 mm (MNHN-B 26748), Fig. 12b].

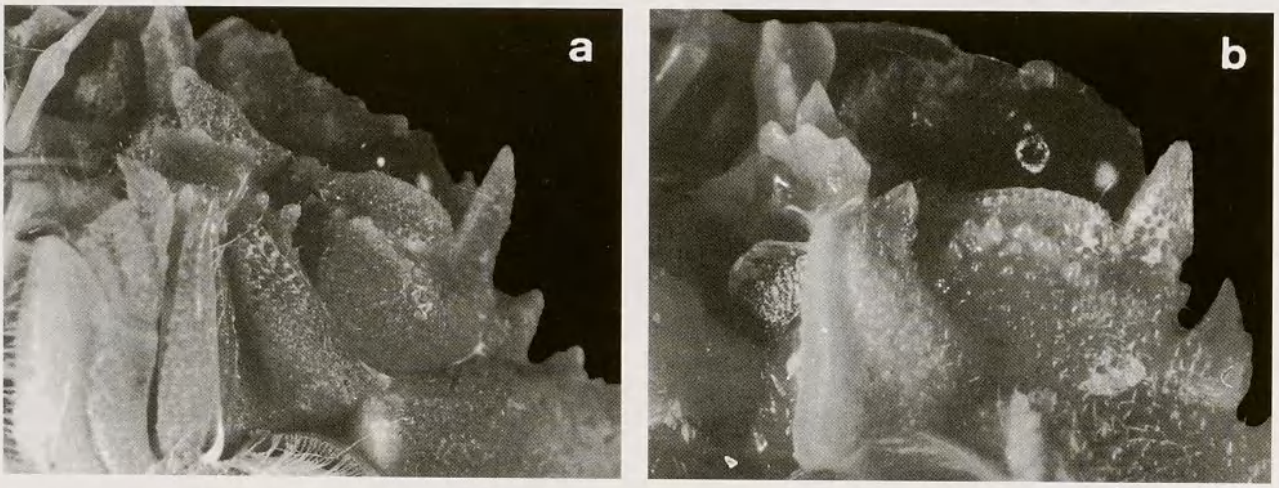


FIG. 9. — **a**, *Pseudopalicus investigatoris* (Alcock, 1900), ♀ 8.2 x 9.5 mm, Fiji, MUSORSTOM 10, stn CP 1324, 102-104 m (MNHN-B 26748): suborbital region. — **b**, *Pseudopalicus serripes* (Alcock & Anderson, 1895), ♂ 10.4 x 11.0 mm, Seychelles, REVES 2, stn 21, 55-60 m (MNHN-B 26750): suborbital region.

DISCUSSION. — Additional morphological characters of *P. investigatoris* are a spherical or slightly flattened cornea of the eyes, which are wider than the base of the eye peduncle. Each peduncle is long and it has two conspicuous granular tubercles on the distal border. The inner edge of each suborbital border is marked by one very conspicuous, pointed tooth slightly higher than the postorbital angle. The tooth is often but not always separated distally from the outer portion of the suborbital border by a narrow notch. The anterior tip of each pterygostomial lobe projects ventrally, thus forming a flat, semicircular structure (often with 1-3 pointed tips when seen ventrally; Fig. 9a) posterior to the inner suborbital tooth. The epistome is vertically inclined, with two narrow, triangular median teeth with very pointed tips flanked on each side by a similar outer process and a rounded margin before joining the pterygostomial lobe. The fingers of the larger cheliped have a cutting edge and no teeth; the fingers of the smaller cheliped are flattened, have triangular teeth, and thick tips. The third pair of walking legs (P4) has relatively short meri (0.5 CL), each with one row of teeth along upper border and one large and conspicuously pointed distal tooth; dactyli are slender (0.3 CL), each with 2-3 large teeth along the posterior border. The fifth pair of pereopods (P5) are short (0.7-0.8 CL), meri each with 5-6 microscopic teeth and tubercles along the posterior border, propodi each with 6-8 slender spines along the posterior border, and dactyli each with 3-5 short spines (thicker distally) along the posterior border, 5-12 along anterior border, and one terminal pointed tooth.

Source : MNHN, Paris

P. investigatoris was described from only one specimen, a "non-adult" male (7 x 8 mm) from the Andaman Islands. Its detailed description (ALCOCK, 1900) and excellent figure (ALCOCK & MCARDLE, 1903, pl. 67, fig. 2; reproduced here as Fig. 8b) has confirmed the status of this species as a distinct one, notwithstanding its close proximity to *P. serripes* (Alcock & Anderson, 1895) and the unavailability of the holotype.

P. investigatoris shares with *P. serripes* very similar characters: 10 large granular bosses that form an almost straight row across the branchial and metagastric regions of the carapace of large specimens; four pointed anterolateral teeth, first three usually of similar size but always much larger than the fourth; a squarish carapace; two triangular and pointed supraorbital lobes; suborbital borders each with one broad and rounded lobe continuous with narrow and straight or slightly rounded inner portion; long and pointed postorbital angles; teeth on the posterior border of the dactyli of the walking legs; epistome with two triangular, pointed median teeth (although long, thin tips are characteristic of *P. investigatoris* and only in some small specimens of *P. serripes*). They also share very similar male first pleopods: simple distal parts armed with small teeth along the inner border. Several characters of *P. investigatoris*, however, separate it from *P. serripes*, some of which are apparent in the figures of ALCOCK & MCARDLE (1903, pl. 67, figs 1-2; reproduced as Figs 8a-b). Differences are summarized in Table 2.

TABLE 2. - Morphological differences between *Pseudopalicus investigatoris* (Alcock, 1900) and *P. serripes* (Alcock & Anderson, 1895).

	Pseudopalicus investigatoris (Alcock, 1900)	***Pseudopalicus serripes*** (Alcock & Anderson,1895)
Frontal lobes	Longer and pointed	Shorter and round
Dorsal surface of carapace	Well-defined and elevated granular bosses	Shallower granular bosses
P3-4 dactyli	Narrower and more slender (P4 0.5-0.6 CL)	Shorter and wider (P4 0.2-0.3 CL)
Teeth on posterior border of P4 dactyli	2-3	3-5
Teeth on ridge connecting pterygostomial lobe with pterygostomial region	2 (1 in some juveniles), sharply pointed	1 broad, round
Distal edge of anterior border of P3-4 meri	Long, pointed tooth-like tubercle	Short, blunt tubercle
Inner surface of cheliped propodi	Smooth	Dense cluster of plumose setae in males
Dorsal surface of cheliped propodi	Pointed tubercles (at least one sharp tubercle on proximal portion)	Round tubercles
Postorbital angles	Long and pointed, extending beyond retracted eye	Shorter and less pointed, extending to just dorsal surface of retracted eye
Posterior border of carapace	Salient, pointed tubercles	Shallow, elongate tubercles
Basal antennal segment	Slender, with pointed distal portion (in ventral view) and relatively shallow tubercles along ventral surface	Expanded along outer border (in ventral view) and one row of conspicuous, round tubercles (particularly larger specimens)
Inner suborbital tooth	Conspicuous and always pointed	Smaller, round or pointed
First male pleopod	Distal part slightly curved and with one dorsal row of teeth (Figs 4b-c)	Distal part S-shaped and with two dorsal rows of teeth (Fig. 4d)

Source : MNHN, Paris

The male first pleopods are only slightly different from those of *P. serripes* in contrast to the sharp differences between other species of palicids. The male first pleopods of *P. investigatoris* are slender, each distal part dorsoventrally flattened, slightly curved, and armed with one dorsal row of small teeth (Figs 4b-c), whereas they are of similar shape (each distal part typically sharply curved and S-shaped) but armed with two dorsal rows of smaller teeth in *P. serripes* (Fig. 4d; MOOSA & SERÈNE, 1981, fig. 5).

Some of the characters given by ALCOCK (1900) as diagnostic for *P. investigatoris* were found to be absent in the largest or smallest specimens. The bosses of the carapace, although described by ALCOCK (1900: 455) as "aureolae... capped by sharp little tubercles" in contrast to "granules" in *P. serripes*, were found to be mostly covered with granules in the larger specimens of *P. investigatoris*. The suborbital border, described by ALCOCK (1900: 455) as having "no fissure" along its inner end in contrast to an inner "fissure" and an outer notch in *P. serripes*, is a variable character in both species. A notch may be present in some individuals. Similarly, the anterior borders of the carpi of the second and third pairs of walking legs (P3-4) may be serrated in *P. investigatoris* as in *P. serripes*, and they are not always smooth as indicated by ALCOCK (1900: 455).

The examination of the holotype of *Cymopolia fisheri* Rathbun, 1906 shows that it is a subjective junior synonym of *P. investigatoris*. RATHBUN (1906: 836) differentiated her new species from *P. investigatoris* by following ALCOCK's premise that the carapace of *P. investigatoris* is covered by tubercles, not granules as in *P. serripes*. She also stated that the frontal lobes of her species were less acute than in *P. investigatoris*. Although the holotype (USNM 29368) has granules, the specimen clearly shows the characters diagnostic for *P. investigatoris* that are illustrated in ALCOCK's figure of the species (ALCOCK & MCARDLE, 1903, pl. 67, fig. 1; reproduced as Fig. 8b), including the more pointed frontal lobes and the slender dactyli of the walking legs.

Although the holotype of *Cymopolia cyrenae* Ward, 1942 (supposedly still at the Mauritius Institute, Port Louis, Mauritius) was not available for examination, WARD's description and poor photograph (WARD, 1942a: 46, pl. 4, figs 1-2) nevertheless provide enough evidence to conclude that his only female specimen is actually conspecific with *P. investigatoris*. WARD referred to *C. cyrenae* as "allied to *C. investigatoris* Alcock" and differentiated the two species by three characters: the presence in *C. cyrenae* of "two petaloid spines" on the carpi of the walking legs, dactyli each with three spines, and by "all the spines" being longer in the new species. Only one distal, pointed tubercle is visible on the merus of each of the second walking legs, the only legs shown on WARD's photograph, not two as he indicated. Although the figure of *P. investigatoris* given by ALCOCK & MCARDLE (1903, pl. 67, fig. 2; reproduced as Fig. 8b) and the only that could have been available to WARD shows only two teeth on each second leg, this is a variable character.

The most important diagnostic characters of *P. investigatoris* are apparent in WARD's photograph: conspicuously pointed supraorbital lobes and postorbital angles, and slender dactyli of the walking legs. Other characters are typical of *P. investigatoris*. The tubercles along the posterior border of the carapace were described by WARD (1942a: 46) as "ten or eleven dentiform spines" (but shown as pointed tubercles on the photograph), each supraorbital border as "cut into three broad spines, the median of which is broadly truncate, the other two sharp, and there is a large spine at the external orbital angle" and shown in the photograph as two pointed suborbital lobes and an elongate, pointed postorbital angle. Each anterolateral border, however, was described as having "three broad acuminate spines". Although only three can be seen in the photograph, it is very possible that the fourth, always the smallest, was much reduced (and therefore not visible in the poor photograph) and not defined as an "acuminate spine" by WARD. The eye peduncles were described as having "spines" which is assumed to refer to pointed tubercles. The character was nevertheless used as a diagnostic feature in the key to the species of *Pseudopalicus* that was given by MOOSA & SERÈNE (1981: 36).

SIZE. — Maximum size among specimens examined: 22.3 x 26.3 mm (female, MNHN-B 26745); 18.7 x 24.4 mm (male, SMF 24707).

DISTRIBUTION. — Mauritius (WARD, 1942a, 1942b; as *Cymopolia cyrenae*), Andaman Islands (ALCOCK, 1900) and the Hawaiian Islands (RATHBUN, 1906; EDMONDSON, 1933, 1946; all as *Cymopolia fisheri*). Its distribution is now extended to Madagascar, Western Australia, Japan ?, South China Sea (off the Philippine Islands), Coral Sea (Vanuatu, New Caledonia, and the Landsdowne-Fairway Banks), and Fiji (Fig. 52). Depth: known reliably between 43 and 366 m; also collected in trawls between 30-300 and 73-426 m.

Source : MNHN, Paris

Pseudopalicus serripes (Alcock & Anderson, 1895)

Figs 4d, 8a, 9b, 12c, 52

Cymopolia serripes Alcock & Anderson, 1895: 208; 1896: pl. 24, fig. 7. — Sakai, 1935: 86, fig. 17; 1936: 208, fig. 111, pl. 58, fig. 1; 1939: 608, 726, pl. 71, fig. 1; 1956: 52.
Palicus serripes - Bouvier, 1897: 65. — Alcock, 1900: 454. — Calman, 1900: 32, pl. 2, figs 20-22. — De Man, 1902: 546. — Alcock & McArdle, 1903: pl. 67, fig. 1. — Laurie, 1906: 431. — Sakai, 1976: 594, pl. 205, fig. 2.
Palicus investigatoris - MacGilchrist, 1905: 265 [non *Pseudopalicus investigatoris* (Alcock, 1900)].
Pseudopalicus serripes - Moosa & Serène, 1981: 37, fig. 5, pl. 2, fig. A. — Takeda, 1982a: 205, fig. 607.
? *Palicus* aff. *serripes* - Takeda & Kurata, 1976: 132, fig. 6e.

Material examined. — **Somalia**. *"Anton Bruun"*, cruise 9: stn 447, 10°00'N, 51°15'E, 59-61 m, 16.12.1964: 2 ♀ (USNM).
Seychelles. Reves 2: stn 21, 05°22.9'S, 56°10.4'E, 55-60 m, 6.09.1980: 1 juv. ♂, 1 ♂ 10.4 x 11.0 mm (MNHN-B 26750).
Sri Lanka. Gulf of Manaar, W.A. Herdman coll.: 1 ♀ (BMNH 1934.1.16.165).
Japan. Boso Peninsula. Tateyama Island, 30-60 m, sand, M. Osawa coll., 22.05.1990: 1 ♂ (CBM-ZC 307).
"Misago": Izu Peninsula (between Ito and Hatsushima), 06.1934: 1 ♂ (SMF 24708).
Indonesia. *Moluccas. Ternate.* W. Kükenthal coll.: 1 ♀ (SMF 4714).
Australia. *Torres Strait.* A.C. Haddon coll.: 1 ♀ (BMNH 1900.11.26.516).
Chesterfield Islands. Corail 2: stn DW 9, 20°53.00'S, 161°35.32'E, 62 m, *Halimeda* sand, 20.07.1988: 1 ♀ (MNHN-B 26829). — Stn DW 34, 19°21.62'S, 158°55.77'E, 47 m, foraminiferans and boulders, 23.07.1988: 1 ♀ (MNHN-B 26830). — Stn DW 61, 19°14.96'S, 158°53.60'E, 54 m, *Halimeda* sand, 24.08.1988: 1 ♂ (MNHN-B 26831).
Chesterfield-Bellona Plateau. Chalcal 1: stn D 55, 21°23.90'S, 158°59.60'E, 55 m, 25.07.1984: 1 ♂, 1 ♀ (MNHN-B 26832).
New Caledonia. Musorstom 4: stn DW 231, 22°33.7'S, 167°10.5'E, 75 m, 1.10.1985: 1 ♀ (MNHN-B 26833).
Smib 5: stn DW 100, 23°22.9'S, 168°05.2'E, 120 m, 14.09.1989: 1 ♀ 10.4 x 11.3 mm (MNHN-B 26749).
Futuna Island. Musorstom 7: stn DW 498, 14°19'S, 178°03'W, 105-160 m, 10.05.1992: 1 ♂ (MNHN-B 26834).

Types. — *Holotype* of *Palicus serripes* Alcock & Anderson, 1895: 1 ♀ 9.5 x 11 mm, India (Alcock & Anderson, 1895). Deposit unknown: Zoological Survey of India, Calcutta ?

Type Locality. — Off Madras coast, southeastern India, shallow water.

Diagnosis. — Carapace (Figs 8a, 12c; Alcock & McArdle, 1903, pl. 67, fig. 1) with four pointed anterolateral teeth on each side; first three teeth usually of similar same size but always much larger than fourth. Dorsal surface of carapace with relatively low, conspicuously granular bosses; posterior border with 10-12 low, elongate tubercles. Supraorbital borders each with two narrow, rounded lobes. Suborbital borders (Fig. 9b) each with one broad, rounded outer lobe; long, pointed tooth on inner portion. One rounded tooth on each pterygostomial ridge connecting pterygostomial lobe with pterygostomial region of carapace (Fig. 9b). Dorsal borders of cheliped propodi with several rounded tubercles; inner surface of propodi of males with dense cluster of plumose setae (see Sakai, 1936, fig. 111c); rounded tubercles on dorsal surfaces of carpi and meri. Propodi and dactyli of walking legs (P3-4) with teeth along anterior borders. Dactyli of walking legs short, broad (P4 0.2-0.3 CL), with teeth along posterior borders (3-5 teeth in P4; Fig. 8a, 12c). Abdomen of mature males with all segments free; one almost complete transverse ridge along segment 3. Male first pleopods (Fig. 4d) with sinuous basal parts; each distal part, with small teeth along inner border. Abdomen of mature females with all segments free, one complete transverse ridge along each segment 1-4 (low ridge may be present along segment 5).

Discussion. — Besides the characters outlined in the diagnosis and those discussed in its differentiation from *P. investigatoris* (see discussion for *P. investigatoris* above), other characters for *P. serripes* include a frontal border of the carapace that is divided into four rounded lobes (inner pair narrower and pointed in some specimens), followed by a border that is folded upward and very slightly pointed anteriorly before the supraorbital border. The postorbital angles are relatively long (they extend to the dorsal border of the retracted eye) and pointed. Each basal antennal segment is slender and rectangular (but expanded along its outer border in larger specimens), and with a row of rounded tubercles along the ventral surface. Each eye peduncle is long and has two granular tubercles on the

Source : MNHN, Paris

distal border and several along the dorsal border. The inner edge of each suborbital border is marked by one blunt to pointed tooth that is slightly higher than the suborbital border; the tooth is sometimes separated distally from the outer portion of the suborbital border by a narrow notch. Each pterygostomial lobe projects ventrally, forming a flat, semicircular structure (with 2-3 pointed tips when seen ventrally; Fig. 9b) posterior to each inner suborbital tooth. The epistome is vertically inclined, with two narrow, triangular median teeth with rounded tips (thin and pointed in some small specimens) flanked on each side by a narrow, triangular outer process. It continues ventrally as two rounded lobes around the buccal region. The third pair of walking legs (P4) has short meri (0.4 CL), one row of teeth along the upper border, and one small and rounded distal tubercle. The fifth pair of pereopods (P5) is short (0.6-0.7 CL). Each merus has 5-7 microscopic teeth (some of which with one spine) arranged as two rows along the posterior border; propodus with 6-9 thick spines along the posterior border; each dactylus with 3-4 slightly more slender spines (longer distally) along the posterior border, 2-3 along the anterior border and one terminal pointed tooth.

P. serripes is very close to *P. investigatoris*. Differences between the two species are outlined in the discussion of *P. investigatoris* (see above) and summarized in Table 2. Reliable characters for the identification of *P. serripes* are the presence of a conspicuous cluster of plumose setae on the inner surfaces of the chelipeds of males (SAKAI, 1936, fig. 111c) and the short and broad dactyli of the walking legs (P2-4; Figs 8a, 12c). Juvenile specimens, however, are difficult to identify.

The male first pleopods are very close in both species. Their shape is very similar, with dorsoventrally flattened distal parts, although it was found to be sharply more sinuous (S-shaped) in most of the specimens of *P. serripes* that were examined in this study. It is armed with two distal rows of smaller teeth in *P. serripes* (Fig. 4d) but only one row of slightly coarser teeth in *P. investigatoris* (Figs 4b-c). The figure given by MOOSA & SERÈNE (1981, fig. 5), however, does not clearly show the two rows of teeth and the distal part is not as sinuous as in most specimens of *P. serripes*. The three specimens examined by them certainly belong to *P. serripes*, not *P. investigatoris* (which they did not examine), because the chelipeds were described as having "inner surface of the palm setose" (MOOSA & SERÈNE, 1981: 39).

A male specimen from the Persian Gulf identified as an undescribed variety of *Palicus investigatoris* by MACGILCHRIST (1905: 265) seems from its description to belong instead to *P. serripes*. The location of the specimen is unknown and could not be examined, but the presence of tubercles along the posterior border that are "broad and blunt" (indeed described as to "resemble more those of *P. serripes*") and outer frontal lobes that are "broad, blunt, and rounded at the end" strongly suggests *P. serripes*. Two other characters that were given, the presence of a fissure on each suborbital border and "densely and finely granular" surface between "sharp little tubercles on the aureolae of the carapace", are present in specimens of both species.

SIZE. — Maximum size among specimens examined: 10.4 x 11.3 mm (female, MNHN-B 26749); 10.4 x 11.0 mm (male, MNHN-B 26750).

DISTRIBUTION. — Persian Gulf (MACGILCHRIST, 1905; as *Palicus investigatoris*); southern India and Sri Lanka (ALCOCK, 1900; LAURIE, 1906); Ternate (DE MAN, 1902) and Banda Sea (Ceram, Aru Islands, and Kai Islands), Indonesia (MOOSA & SERÈNE, 1981); Japan (SAKAI, 1935, 1936, 1939, 1956, 1976; TAKEDA, 1982a), and Torres Strait, Queensland, Australia (CALMAN, 1900). It is now recorded for the first time from Somalia, Seychelles, Coral Sea (Chesterfield Islands, Chesterfield-Bellona Plateau, and New Caledonia), and Futuna Island, southwestern Pacific Ocean (Fig. 52). SAKAI (1976: 594) records it from "muddy sand or broken shells" in Japan. Depth: known reliably between 30 m (SAKAI, 1976) and 120 m; also collected in a trawl between 105-160 m.

Pseudopalicus sp.

Fig. 10

MATERIAL EXAMINED. — **Japan**. *Ryukyu Islands*. Okinawa, off Horseshoe Cliffs, west-northwest Onna Village, stn RFB 966, 26°30.0'N, 127°50.9'E, 79 m, R.F. BOLLAND coll., 14.11.1981: 1 ♀ 6.3 x 7.5 mm (USNM).

Source : MNHN, Paris

DIAGNOSIS. — Carapace (Fig. 10a) with four pointed anterolateral teeth on each side; first three teeth of similar same size but much larger than fourth. Dorsal surface of carapace with relatively low, conspicuously granular bosses; posterior border with eight low, elongate tubercles. Supraorbital borders each with one rounded inner lobe; one very short, rounded outer lobe. Suborbital borders (Fig. 10b) each with one pointed inner lobe; outer lobe divided into two pointed, close-together lobes. Dorsal borders of cheliped propodi with several rounded tubercles. Propodi and dactyli of walking legs (P3-4) with conspicuous teeth along anterior borders. Dactyli of walking legs (Fig. 10c) slender (P4 0.2 CL), with triangular teeth along posterior borders. P5 thick, with thick spines along posterior borders of propodi and anterior and posterior borders of dactyli.

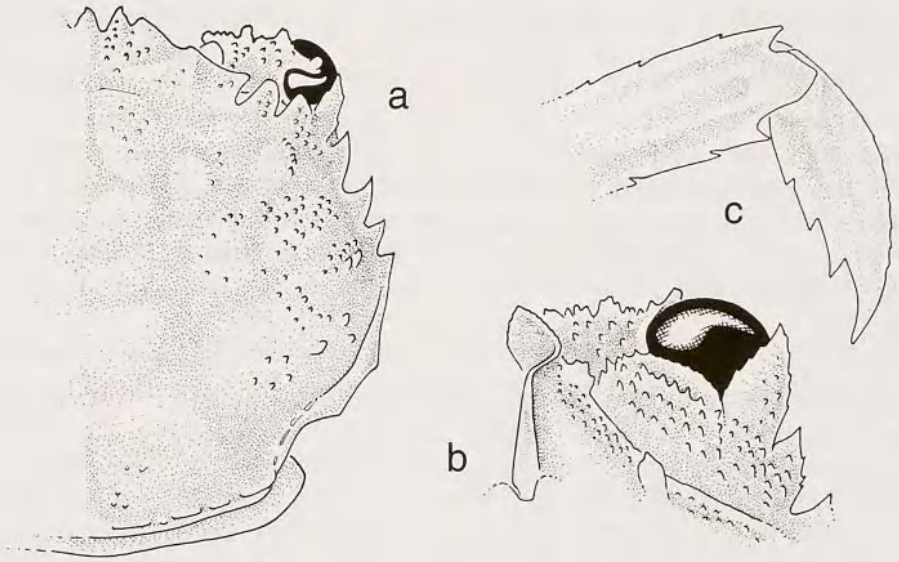


FIG. 10. — *Pseudopalicus* sp., ♀ 6.3 x 7.5 mm, Okinawa, Ryukyu Islands, Japan, stn RFB 966, 79.2 m (USNM): **a**, carapace, dorsal surface; **b**, suborbital border; **c**, dactylus, right fourth pereopod, dorsal view.

DISCUSSION. — An incomplete female specimen (missing the abdomen and one each of the chelipeds, P3, P4, and P5) from the Ryukyu Islands was found to share some superficial characters with *P. serripes*, but the presence of several features unique to the genus suggests that it probably represents a new species. As there is only one incomplete female specimen available, however, the species is not described as new here.

Similar to *P. serripes* are the morphology of the dorsal surface of the carapace, chelipeds, and walking legs. Significant differences are the broad and rounded frontal lobes (narrower in *P. serripes*), eight elongate tubercles along the posterior border of the carapace (10-12 in *P. serripes*), supraorbital borders, each with one rounded inner lobe and one very broad and short outer lobe (both lobes narrow, rounded, and nearly equal in *P. serripes*), suborbital borders each with one pointed inner lobe and an outer lobe that is uniquely divided into two pointed, close-together lobes (pointed tooth on inner border and one broad, rounded outer lobe in *P. serripes*), and the pterygostomial lobes are straight and pointed (ventrally inclined and with 2-3 pointed tips in *P. serripes*; Figs 9b, 10b). The posterior borders of the propodi and dactyli of P2-4 are armed with spines and teeth. Another unique feature is the fifth pair of pereopods (P5). They are thick, short (0.7 CL), the surface of each merus is covered with small tubercles and long, plumose setae. The meri and propodi are also unusually spiny, with several rows of thick spines of various sizes (a total of 17 along posterior border of each propodus) and similar spines along both borders of the thick and short (0.01 CL) dactyli (three thick spines along each posterior side and one along anterior side, plus several smaller spines). There are also spines on the basis-ischia and carpi.

SIZE. — Only specimen known: 6.3 x 7.5 mm (female, USNM).

DISTRIBUTION. — Known only from Okinawa, Ryukyu Islands, Japan. Depth: 79 m.

Source : MNHN, Paris

Pseudopalicus pictus sp. nov.

Figs 11, 12d, 54, 60e

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn DW 965, 20°20.40'S, 169°51.36'E, 361-377 m, 21.09.1994: 1 ♀ paratype 9.7 x 11.2 mm (MNHN-B 26693). — Stn DW 1042, 16°52.61'S, 168°27.65'E, 200-265 m, 30.09.1994: 1 ♂ holotype 8.6 x 10.4 mm (MNHN-B 26690).

French Polynesia. *Marquesas Islands. Eiao Island.* MUSORSTOM 9: stn CP 1159, 07°58.3'S, 140°43.7'W, 145 m, 23.08.1997: 1 ♀ (MNHN-B 26818), 1 ♂ paratype 7.4 x 8.9 mm (MNHN-B 26692), 1 ♀ paratype 9.0 x 9.9 mm (USNM).

Hiva Oa Island. MUSORSTOM 9: stn DW 1218, 09°44.5'S, 138°50.9'W, 125-135 m, 30.08.1997: 1 juv. ♀ paratype 8.8 x 10.8 mm (MNHN-B 26694), 1 ♀ (MNHN-B 26816). — Stn DW 1236, 09°41'S, 139°04'W, 250-400 m, 31.08.1997: 1 ♂ (MNHN-B 26817). — Stn CP 1237, 09°41.9'S, 139°03.6'W, 95-305 m, 31.08.1997: 1 ♂ paratype 6.8 x 8.2 mm (MNHN-B 26691).

Fatu Hiva Island. MUSORSTOM 9: stn DW 1242, 10°28.1'S, 138°41.1'W, 119-122 m, 1.09.1997: 1 juv. ♂, 2 juv. ♀ (MNHN-B 26819).

TYPES. — *Holotype*: 1 ♂ 8.6 x 10.4 mm, MUSORSTOM 8, stn DW 1042 (MNHN-B 26690).

Paratypes: 1 ♂ 6.8 x 8.2 mm, MUSORSTOM 9, stn CP 1237 (MNHN-B 26691); 1 ♂ 7.4 x 8.9 mm, MUSORSTOM 9, stn CP 1159 (MNHN-B 26692); 1 ♀ 9.7 x 11.2 mm, MUSORSTOM 8, stn DW 965 (MNHN-B 26693); 1 juv. ♀ 8.8 x 10.8 mm, MUSORSTOM 9, stn DW 1218 (MNHN-B 26694); 1 ♀ 9.0 x 9.9 mm, MUSORSTOM 9, stn CP 1159 (USNM).

TYPE LOCALITY. — Off southeast coast of Epi Island, Vanuatu, 16°52.61'S, 168°27.65'E, 200-265 m.

DIAGNOSIS. — Carapace (Figs 11a, 12d, 60e) with four pointed anterolateral teeth on each side; second tooth slightly wider than the rest. Dorsal surface of carapace covered by large granules and few small, low granular bosses, mostly on branchial and metagastric regions; posterior border with 9-10 elongate tubercles. Supraorbital borders each with two triangular, pointed lobes. Suborbital borders (Fig. 11b) each with one slightly rounded lobe; long, pointed tooth on inner portion. Dorsal borders of cheliped propodi with several rounded or pointed tubercles. Propodi and dactyli of walking legs (P3-4) with teeth along anterior borders (1-4 large teeth on each dactylus of P4; Fig. 11c). Abdomen of mature males with all segments free, each with complete transverse ridge, one complete but low ridge along segments 1-3. Male first pleopods (Figs 11d-e) with sinuous basal parts; each distal part thick, with pointed, toothed tip sharply bent distally. Abdomen of mature females with all segments free, one complete transverse ridge along each segment 1-3 (short ridge at each edge of segment 4).

Color: Live specimens (Fig. 60e) with irregular, dark-brown pattern on the carapace and dark-brown legs distally banded with white, which remains in preserved specimens as a variegated red-brown pattern.

DESCRIPTION. — Carapace (Figs 11a, 12d, 60e) transversely hexagonal, slightly squarish, wider than long (CW/CL = 1.1-1.2); dorsal surface covered with large granules and few, low, granular bosses (most conspicuous bosses on branchial and metagastric regions). Anterolateral borders of carapace each with four pointed teeth, second slightly wider, fourth much smaller than first three. Row of low, rounded tubercles along each posterolateral border. Posterior border with 9-10 elongate or rounded tubercles, iridescent plumose setae.

Frontal border of carapace divided into four pointed lobes (inner lobes narrower). Borders between frontal lobes and supraorbital borders slightly pointed anteriorly, folded upward, concave, ending in pointed tip, forming U- or V-shaped fissure before supraorbital border. Supraorbital borders each with two pointed lobes with slightly rounded tips. Postorbital angles moderately long (extend just to dorsal border of retracted eye), slender, pointed. Cornea of eyes dorsoventrally flattened, wider than base of moderately long eye peduncle; each peduncle with four conspicuous, granular tubercles: two median (most ventral conspicuously elongate, pointed), two on distal border.

Suborbital borders (Fig. 11b) each with one broadly rounded outer lobe (limited on outer and inner edges by notch or wide fissure); conspicuous, pointed tooth on inner limit of suborbital border. Pterygostomial lobes project ventrally, forming flat, semicircular structure (sometimes notched on inner side) as long as or slightly shorter than tooth on inner limit of each suborbital border. Sharp tooth on each pterygostomial ridge connecting pterygostomial lobe with pterygostomial region of carapace.

Source : MNHN, Paris

Each basal antennal segment slender, rectangular (slightly pointed distal border in ventral view); flagellum long, with few, simple setae. Epistome vertically inclined, with two triangular median teeth with thin, pointed-tips, each flanked by triangular outer process and thin, rounded margin before pterygostomial lobe. Inner border of ischia of third maxillipeds straight; surface coarsely granular, upper borders rounded. Meri much narrower than ischia; upper lobes straight with rounded outer borders.

Dorsal and outer borders of cheliped propodi each with one row of 2-9 thin, rounded (some pointed) tubercles, at least one of which expanded as high, thin, semicircular process. Fingers of largest cheliped with cutting edges (broadly rounded teeth in some specimens); smallest cheliped only with sinuous edge except some males (5-7 rounded teeth). Carpi short, outer borders with one thin, broadly rounded tubercle, several pointed tubercles; meri slender, with few pointed tubercles.

First three pairs of walking legs (P2-4; Figs 12d, 60e) flattened. Upper and lower borders of meri with tubercles of different sizes and shapes (mostly pointed, some rounded; smaller but on two anterior rows in P2-3); distalmost tubercle on each anterior border much wider at base, much higher, slender, pointed, directed distally. Anterior borders of carpi of walking legs (P2-4) with pointed tubercles; anterior borders of propodi and carpi with teeth. Each P2 with one ventral row of tubercles on merus; 1-2 dorsal, 1-2 ventral row of tubercles on carpus; two dorsal, 2 ventral carinae, 4-5 teeth along posterior border of broad propodus; 1-2 dorsal, two ventral carinae, two teeth on dactylus. Each P3 with one ventral row of tubercles on merus; two dorsal, one ventral row of tubercles on carpus; 1-2 dorsal, two ventral carinae, 2-6 teeth along posterior border of broad propodus; 1-2 dorsal, two ventral carinae, 1-4 teeth on dactylus. Each P4 with two dorsal, one ventral row of tubercles on carpus; one dorsal, two ventral carinae, 4-5 teeth along the posterior border of broad propodus; 1-2 dorsal, 1-2 ventral carinae, 1-4 teeth on dactylus (Fig. 11c). Meri of all walking legs (and carpi, propodi of P3-4) with numerous iridescent plumose setae; distal border of propodi and dorsal surface of anterior borders of propodi and dactyli of P3-4 each with one row of conspicuous plumose setae.

First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair slightly shorter than second. Fifth pair of pereopods (P5) short (0.8-0.9 CL); each merus slender, surface with microscopic tubercles, many microscopic tubercles and plumose setae along posterior border; each propodus with 4-6 spines along posterior border; each dactylus with 3-9 short, thick spines along posterior border, 3-8 short spines along anterior border, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	0.9-1.1	1.5-1.9	1.5-1.7	0.8-0.9
Merus length/CL	0.3	0.4-0.5	0.5	0.3
Dactylus length/Cl	0.2-0.3	0.3-0.4	0.3-0.4	0.2-0.3

Abdomen of mature males with all segments free. One complete transverse ridge along each segment 1-3. Male first pleopods (Figs 11d-e) with sinuous basal parts; each distal part thick, with pointed, toothed tip sharply bent distally.

Abdomen of mature females with all segments free. One transversal ridge along each segment 1-3; short ridge at each outer edge of segment 4.

DISCUSSION. — *P. pictus* shares with *P. investigatoris* and *P. serripes* a similar shape of the carapace (squarish, with pointed anterolateral teeth), teeth on the propodi and dactyli of the walking legs (P2-4), a similar arrangement of the suborbital borders (broad outer lobe and large tooth on the inner limit of the border), and a tooth on the proximal portion of the ridge that connects the pterygostomial lobe with the pterygostomial region (Fig. 11b). It can be clearly differentiated from both species, however, by its unique male first pleopods, which have thick, sharply bent distal parts (Figs 11d-e), and the smoother appearance of the surface of its carapace. As in *P. investigatoris*, the inner surfaces of the male chelipeds lack clusters of setae, in contrast to the cluster of plumose setae in the male of *P. serripes*.

Source : MNHN, Paris

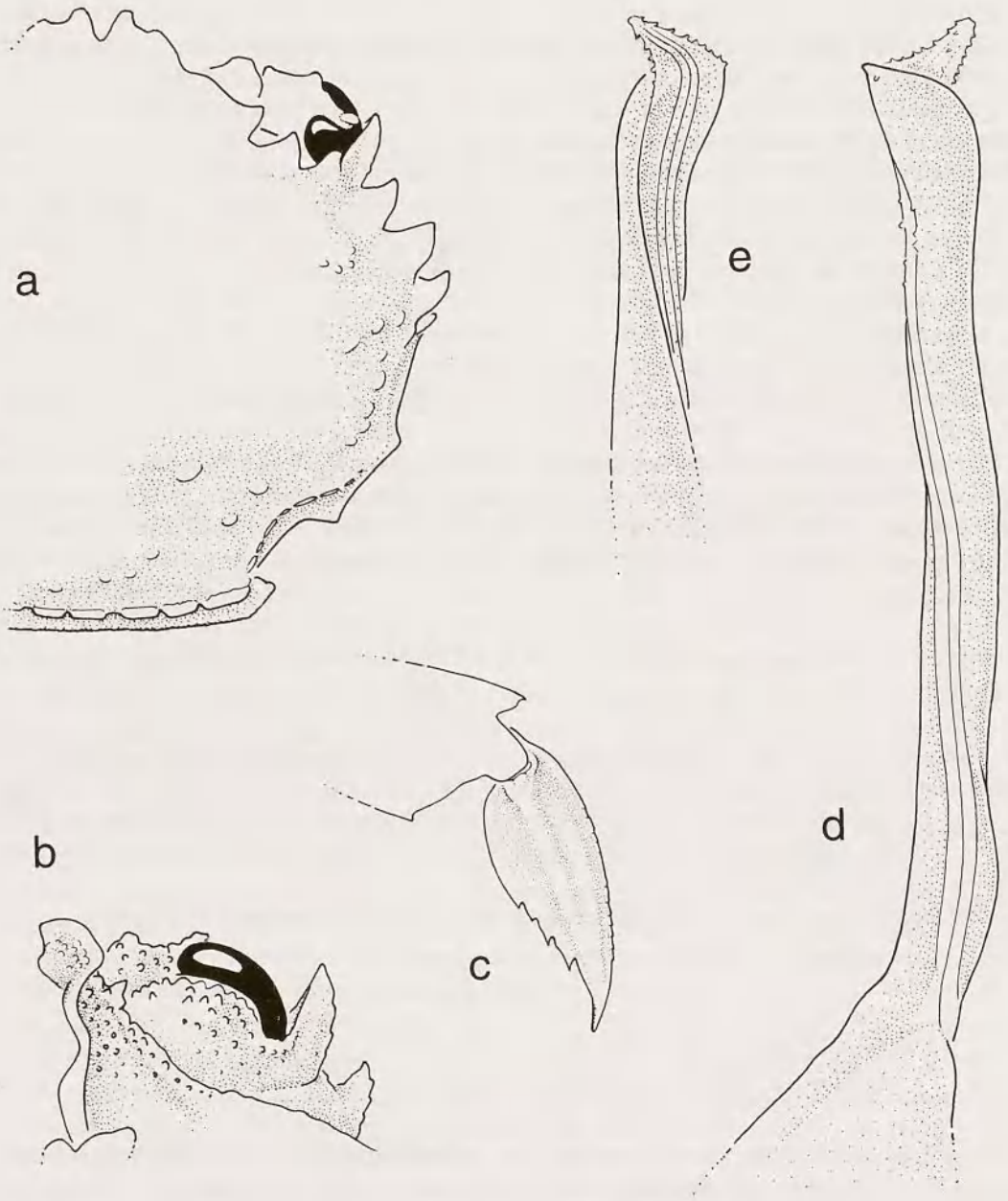


FIG. 11. — *Pseudopalicus pictus* sp. nov., ♂ holotype 8.6 x 10.4 mm, southeast of Epi Island, Vanuatu, MUSORSTOM 8, stn DW 1042, 200-265 m (MNHN-B 26690): **a**, carapace, dorsal surface; **b**, suborbital border; **c**, dactylus, right fourth pereopod, dorsal view; **d**, left male first pleopod, ventral view; **e**, left male first pleopod, distal part, dorsal view.

SIZE. — Maximum size among specimens examined: 9.7 x 11.2 mm (female, MNHN-B 26693); 8.6 x 10.4 mm (male, MNHN-B 26690).

ETYMOLOGY. — From the Latin *pictus*, for painted, in reference to the variegated color pattern of the carapace and the banded legs, which remain evident in preserved specimens, and the color effect that results from the numerous iridescent plumose setae.

DISTRIBUTION. — Coral Sea (Vanuatu) and French Polynesia (Fig. 54). Depth: known reliably between 120 and 370 m; also collected in trawls between 95-305 and 250-400 m.

Source : MNHN, Paris

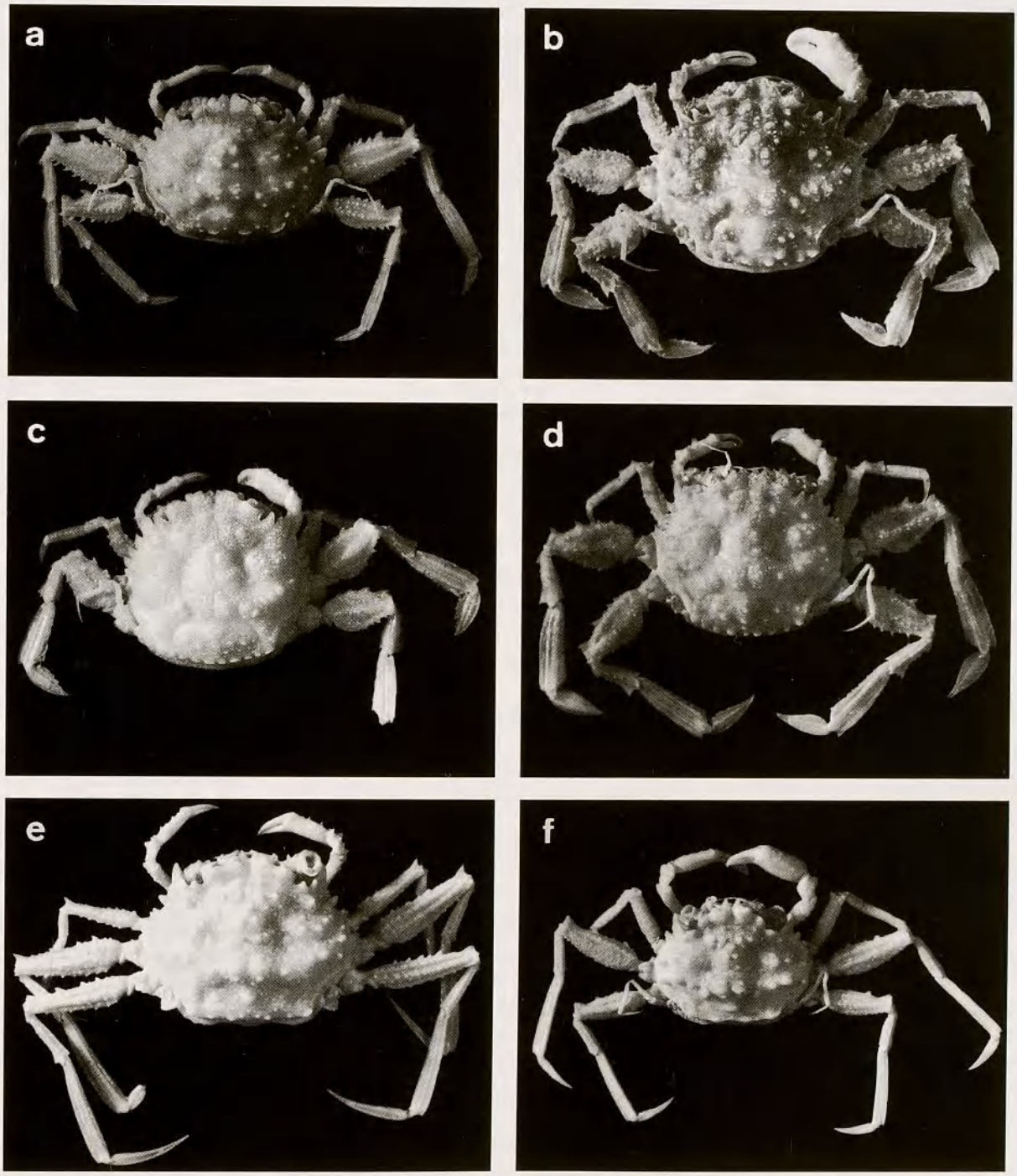


FIG. 12. — **a**, *Pseudopalicus oahuensis* (Rathbun, 1906): ♀ 11.7 x 15.8 mm, off southwest coast of New Caledonia, MUSORSTOM 4, stn CP 238, 500-510 m (MNHN-B 26749): dorsal view. — **b**, *Pseudopalicus investigatoris* (Alcock, 1900), ♀ 8.2 x 9.5 mm, Fiji, MUSORSTOM 10, stn CP 1324, 102-104 m (MNHN-B 26748): dorsal view. — **c**, *Pseudopalicus serripes* (Alcock & Anderson, 1895), ♀ 10.4 x 11.3 mm, Norfolk Ridge, south of New Caledonia, SMIB 5, stn DW 100, 120 m (MNHN-B 26749): dorsal view. — **d**, *Pseudopalicus pictus* sp. nov., juv. ♀ paratype 8.8 x 10.8 mm, Marquesas Islands, French Polynesia, MUSORSTOM 9, stn DW 1218, 125-135 m (MNHN-B 26694): dorsal view. — **e**, *Pseudopalicus macromeles* sp. nov., ♀ 9.7 X 11.7 mm, *"Diamantina"* , west of Rottnest Island, Western Australia, stn 78, 146-150 m (WAM C.23580): dorsal view. Unidentified, tubiculous polychaete worm on right eye. — **f**, *Pseudopalicus undulatus* sp. nov., ♂ paratype 7.3 x 9.0 mm, Vanuatu, MUSORSTOM 8, stn DW 977, 410-505 m (MNHN-B 26696): dorsal view.

Source : MNHN, Paris

Pseudopalicus macromeles sp. nov.

Figs 12e, 13, 52

MATERIAL EXAMINED. — **Western Australia**. *"Diamantina"*, cruise DM 6/63: stn 225, west of Rottnest Island, 32°00'S, 115°16'E, 137-143 m, 12.10.1963: 1 ♂ paratype 7.5 x 8.6 mm (WAM C.24386), 1 ♀ paratype 10.2 x 12.1 mm (WAM C.24387), 1 ♂ 8.0 x 9.4 mm, 21 ♀ (WAM C.23575); 1 ♂ paratype 6.8 x 7.5 mm, 1 ♀ paratype 8.5 x 10.3 mm (MNHN-B 26689).

"Diamantina", cruise DM 1/72: stn 8, northwest of Bunbury, 32°37.5'S, 114°48'E, 139-122 m, 15.03.1972: 2 ♀ (WAM C.23582). — Stn 34, west of Garden Island, 32°19'S, 115°07'E, 148-154 m, 18.03.1972: 1 ♀ (WAM C.23574). — Stn 55, west of Dongara, 29°15'S, 114°01'E, 146 m, 20.03.1972: 5 ♀ (WAM C.23577). — Stn 61, west southwest of Dongara, 29°31'S, 114°11'E, 227-221 m, 21.03.1972: 1 ♀ (WAM C.23572). — Stn 64, northwest of Green Head, 29°58'S, 114°27'E, 197-219 m, 22.03.1972: 1 ♀ (WAM C.23570). — Stn 66, northwest of Green Head, 29°59'S, 114°25'E, 146 m, 22.03.1972: 1 ♀ 10.4 x 12.6 mm (WAM C.23569). — Stn 68(1), northwest of Green Island, 30°34'S, 114°44'E, 146-139 m, 22.03.1972: 1 ♀ (WAM C.23567). — Stn 68(3), northwest of Green Island, 30°34'S, 114°44'E, 128 m, 22.03.1972: 3 ♀ (WAM C.23568). — Stn 73(1), west southwest of Lancelin, 31°04'S, 113°50'E, 256 m, 23.03.1972: 1 ♂, 2 ♀ (WAM C.23576). — Stn 78, west of Rottnest Island, 32°00'S, 115°15'E, 146-150 m, 23.03.1972: 1 ♂ holotype 7.4 x 8.6 mm (WAM C.24385), 1 ♀ paratype 8.1 x 10.0 mm (WAM C.24388), 1 ♂, 9 ♀ (WAM C.23580). — Stn 78(2), west of Rottnest Island, 32°00'S, 115°15'E, 137-146 m, 23.03.1972: 2 ♀ (WAM C.23581). — Stn 79, west of Rottnest Island, 31°59'S, 115°14'E, 182 m, 23.03.1973: 2 ♂ (WAM C.23579). — 03.1972: 1 ♂, 4 ♀ (WAM C.23573).

"Sprightly": stn 22, 75 km west of Cliff Head, 29°31'S, 114°15'E, 145 m, 18.02.1976: 1 ♀ (WAM C.14325).

TYPES. — *Holotype*: 1 ♂ 7.4 x 8.6 mm, *"Diamantina"*, stn 78 (WAM C.24385).

Paratypes: 1 ♂ 7.5 x 8.6 mm, *"Diamantina"*, stn 225 (WAM C.24386); 1 ♀ 10.2 x 12.1 mm, *"Diamantina"*, stn 225 (WAM C.24387); 1 ♀ 8.1 x 10.0 mm, *"Diamantina"*, stn 78 (WAM C.24388); 1 ♂ 6.8 x 7.5 mm, 1 ♀ 8.5 x 10.3 mm, *"Diamantina"*, stn 225 (MNHN-B 26689).

TYPE LOCALITY. — West of Rottnest Island, Western Australia, 32°00'S, 115°15'E, 146-150 m.

DIAGNOSIS. — Carapace (Figs 12e, 13a) with three granular anterolateral teeth on each side; teeth decrease posteriorly in size. Dorsal surface of carapace covered by large granules and several granular bosses, some rounded, high, particularly 6-7 on each branchial region; posterior border with 4-6 rounded, granular tubercles. Supraorbital borders each with two triangular lobes. Suborbital borders (Fig. 13b) each with two rounded lobes (high, narrow inner lobe, broad outer lobe). Dorsal borders of cheliped propodi with several rounded or pointed tubercles. Dactyli of walking legs (P2-4) very slender, with posterior borders entire (Fig. 13c). Abdomen of mature males with all segments free, one complete transverse ridge along each segment 1-3, incomplete ridge along segment 4. Male first pleopods (Figs 13d-e) with sinuous basal parts; each distal part with two broad lateral processes, inner one broader, bordered by thicker portion, outer one narrower, armed with teeth. Abdomen of mature females with all segments free, one complete transverse ridge along each segment 1-4.

DESCRIPTION. — Carapace (Figs 12e, 13a) transversely hexagonal, wider than long (CW/CL = 1.1-1.2); dorsal surface covered with large conspicuous granules and granular bosses (most conspicuous 6-7 on each branchial region, continuing as a row of smaller bosses to two salient bosses on metagastric region). Sulcus between hepatic and branchial regions apparent. Anterolateral borders of carapace each with three granular, anteriorly pointed teeth decreasing posteriorly in size (last one can be very small, as in holotype; Fig. 13a). Episternal processes granular, reduced (short, rounded) in males and immature females, more pronounced (elongate) in females. Posterior border with 4-6 rounded, granular tubercles, scattered plumose setae.

Frontal border of carapace divided into four rounded to pointed lobes (inner lobes longer). Borders between frontal lobes and supraorbital borders folded upward, nearly straight (slightly rounded in some specimens), and ending in sharp angle, forming U- or V-shaped fissure before supraorbital border. Supraorbital borders each with two triangular, pointed (tips slightly rounded in some specimens) lobes. Postorbital angles long (extend beyond dorsal border of retracted eye), pointed inward. Cornea of eyes dorsoventrally flattened, wider than base of short eye peduncle; each peduncle with three granular tubercles on distal border (two dorsal tubercles most conspicuous).

Source : MNHN, Paris

Suborbital borders (Fig. 13b) each with high, narrow, rounded inner lobe; broadly rounded outer lobe. Pterygostomial lobes project ventrally, forming semicircular structure posterior to each inner suborbital lobe.

Each basal antennal segment slender, rectangular (slightly expanded distally, with pointed distal border in ventral view), and tuberculate; flagellum long, with few, simple setae. Epistome vertically inclined, with two short, triangular median teeth and wide, rounded margin before pterygostomial lobe. Inner border of ischia of third maxillipeds straight; surface coarsely granular, upper borders obliquely-directed. Meri much narrower than ischia; upper lobes much reduced, with straight outer borders.

Chelipeds equal or slightly unequal in females, conspicuously unequal in males. Dorsal borders of propodi of small chelipeds of both sexes each with one row of pointed, thin, elongate tubercles, outer border with 1-2 rows of low, rounded tubercles. Large cheliped of males with high propodus armed with 3-4 rows of conspicuous, rounded tubercles decreasing in size ventrally. Fingers of small chelipeds of both sexes each with 3-4 broadly rounded or triangular (particularly in males) teeth or cutting edges. Carpi of small and large chelipeds of both sexes short, outer borders with conspicuous pointed, rounded tubercles; meri slender, with pointed, rounded tubercles.

First three pairs of walking legs (P2-4; Fig. 12e) very slender, without filiform propodi. Upper and lower borders of meri with tubercles of different sizes and shapes (mostly rounded, some pointed; smaller in P2); distalmost tubercle on each anterior border of meri of P2-3 much wider at base, much higher, slender, pointed or rounded, directed distally (short, truncate in P4). Carpi and dactyli of walking legs (P2-4) elongate; anterior borders of carpi tuberculate; borders of propodi and dactyli (Fig. 13c) entire. Each P2 with one ventral row of tubercles on merus; one dorsal, one ventral carinae on carpus; one dorsal, 1-2 ventral carinae on propodus; one dorsal, two ventral carinae on dactylus. Each P3 with one dorsal, one ventral row of tubercles on merus (very low in some specimens); two dorsal, two ventral carinae each on carpus, propodus, and dactylus. Each P4 with two dorsal, one ventral row of tubercles on merus; one dorsal, one ventral carinae on carpus; two dorsal, two ventral carinae on propodus; one dorsal, two ventral carinae on dactylus. Meri of all walking legs with scattered plumose setae, few on carpi; dorsal surfaces of propodi and dactyli of P3-4 each with one row of conspicuous plumose setae along anterior border.

First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair slightly shorter than second. Fifth pair of pereopods (P5) short (0.9 CL); each merus slender, surface with microscopic tubercles, 2-4 spines along posterior border, 0-2 thick spines along anterior border; each propodus with 6-9 long spines along anterior border; each dactylus with 0-3 spines along posterior border, 0-2 thick spines along anterior border, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.4-1.6	2.3-2.5	2.2-2.3	0.9
Merus length/CL	0.4-0.5	0.7-0.8	0.6-0.7	0.3
Dactylus length/Cl	0.4	0.6	0.6	0.2

Abdomen of mature males with all segments free. One complete transverse ridge along each segment 1-3, low, incomplete ridge along most of segments 4-6 (very low, if present, in segments 5-6). Male first pleopods (Figs 13d-e) with sinuous basal parts; each distal part with two broad lateral processes, inner one broader and bordered by thicker portion, outer one (with sperm channel) narrower and armed with teeth.

Abdomen of mature females with all segments free. One transversal ridge along each segment 1-4 (very low in segment 4 and, if present, in segment 5).

DISCUSSION. — An unusual feature of *P. macromeles* is its very long walking legs (P2-4; Fig. 12e), a characteristic of species of *Parapalicus* and *Miropalicus*. However, in contrast to *Miropalicus*, and as in *Pseudopalicus* and *Parapalicus*, the last pair of walking legs (P4) is about the same length as the second pair (P3) and much longer than the first pair (P2). The total length of the walking legs, however, is a function of the shape of the dactyli, which varies among the species of *Pseudopalicus* but are always slender and long in *Parapalicus*. Thus, total length of the P3 varied between 2.3-2.5 CL in males and females of *Pseudopalicus macromeles*,

Source : MNHN, Paris

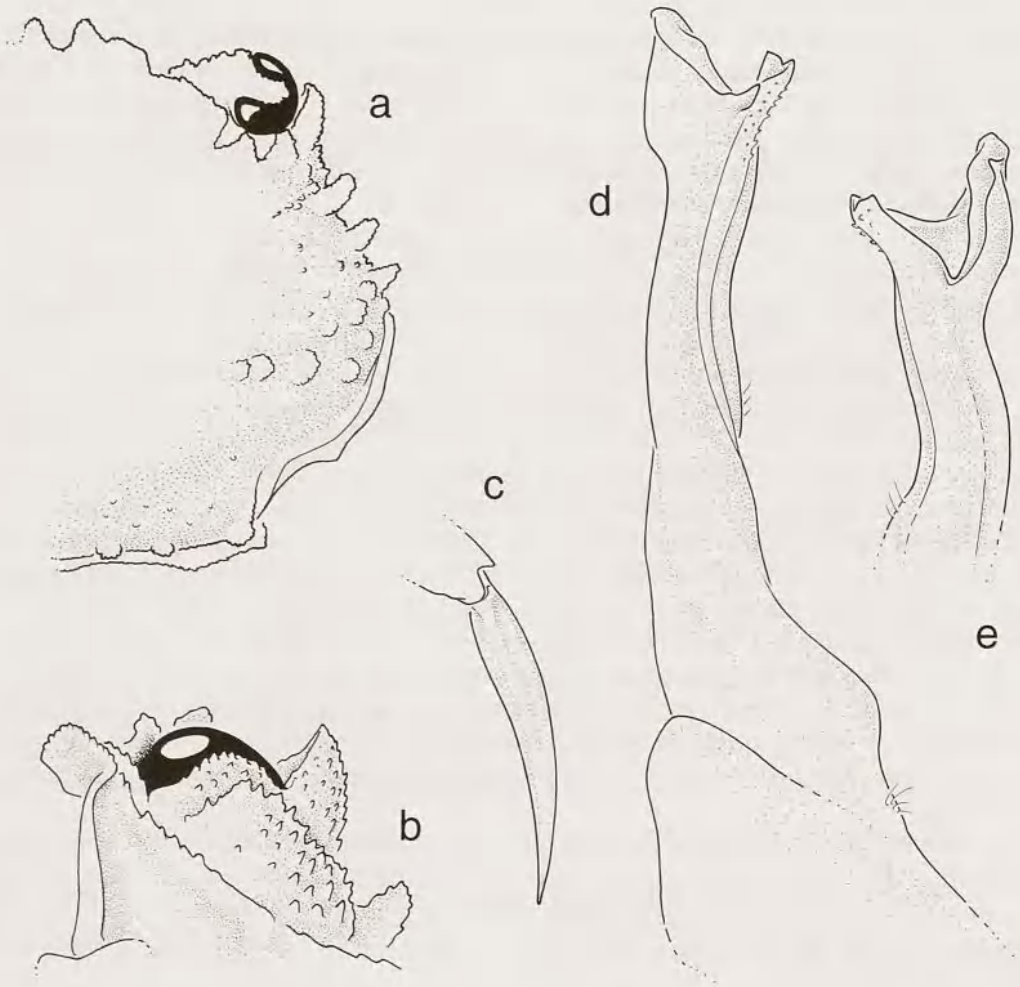


FIG. 13. — *Pseudopalicus macromeles* sp. nov., ♂ holotype 7.4 x 8.6 mm, west of Rottnest Island, Western Australia, *"Diamantina"*, stn 78, 146-150 m (WAM C.24585): **a**, carapace, dorsal surface; **b**, suborbital border; **c**, dactylus, right fourth pereopod, dorsal view; **d**, left male first pleopod, ventral view; **e**, left male first pleopod, distal part, dorsal view.

2.0 CL in *Pseudopalicus declivis* (a species with slender dactyli), 1.7 CL in *Pseudopalicus serripes* (a species with short dactyli), and 2.7 CL in both *Parapalicus ambonensis* (Moosa & Serène, 1981) and *P. unidentatus* (Zarenkov, 1968). Furthermore, the walking legs of *P. macromeles* are morphologically identical to the legs of the other species of *Pseudopalicus*. They all have relatively short and broad meri with unequal tubercles arranged as rows along anterior and posterior sides and as a single row of unequal (some much broader and triangular) tubercles along both the upper (dorsal) and lower (ventral) borders; the carpi are short and their upper borders have irregular, triangular tubercles, particularly on the proximal and distal portions; and the coxae of each P3-4 are broad, laminar, with thin anterior and posterior borders. In contrast, the walking legs among the species of *Parapalicus* have longer, narrower meri with more homogenous tubercles throughout their surface and much longer, more slender carpi with only microscopic tubercles (an exception being *P. armatus*, with equal, pointed tubercles on the carpi of P3-4; see Fig. 17a); and the coxae are not broad and laminar, with the anterior and posterior borders rounded.

Another character *P. macromeles* shares with *Parapalicus* is the presence in females of conspicuous episternal processes that protrude from each posterolateral margin of the carapace. It is reduced, as in other species of *Pseudopalicus*, in the male and immature females. The functional significance of this character is unknown. It may act as stabilizers in larger, heavier individuals, like mature females, for sliding over soft sediments as live

Source : MNHN, Paris

individuals of *Parapalicus* species have been observed doing (B. RICHER DE FORGES, personal communication). *Miropalicus vietnamensis* (Zarenkov, 1968), however, has very long, slender walking legs but the episternal process is substantially reduced. It may be suggested that *P. macromeles* has departed from the basic *Pseudopalicus*-type walking legs and has secondarily evolved by convergence longer *Parapalicus*-type legs, as an adaptation for sliding. No other species of *Parapalicus* have ever been collected along the Indian Ocean coast of Western Australia, where *P. macromeles* is only known to occur.

Otherwise, the structure of the carapace (including anterior, anterolateral, supraorbital, and suborbital borders), antennae, epistome, and abdomen of *P. macromeles* are like those characteristic of *Pseudopalicus* and different from *Parapalicus* (see Table 1). The chelipeds of the males are like those in the other species of *Pseudopalicus*, where the fingers of the larger cheliped have cutting edges or rounded teeth and the smaller cheliped has triangular teeth and becomes flatter with increasing size. In females, however, both chelipeds are about the same size, with slender fingers armed with triangular teeth.

P. macromeles is close to *P. undulatus* sp. nov. They are the only two species of *Pseudopalicus* with only three conspicuous anterolateral teeth. They also share male first pleopods where the sperm channel follows a strongly sinuous (S-shaped), although not helicoidal, path along each basal part of the pleopods. This is a departure from the slightly sinuous basal part that is characteristic of congeners. The remaining characters of the pleopods, however, are very different in both species. In *P. undulatus* (Figs 14d-e), there is a unique median tubercle (present also in *Rectopalicus amphiceros* sp. nov.; Fig. 35d) and the distal part is dorsoventrally-flattened and bordered with teeth. In *P. macromeles*, in contrast, there are two broad processes similar to those in *P. acanthodactylus* (Figs 3e-f), *P. declivis* (Figs 6d-e), and *P. oahuensis* (Figs 4e-f).

SIZE. — Maximum size among specimens examined: 10.4 x 12.6 mm (female, WAM C.23569); 8.0 x 9.4 mm (male, WAM C.23575).

ETYMOLOGY. — From *makros*, Greek for long, and *melos*, Greek for limb, to refer to the diagnostic, very long walking legs (P2-4).

DISTRIBUTION. — Known only from the eastern Indian Ocean off the coast of Western Australia (Fig. 52). Depth: 128-256 m.

Pseudopalicus undulatus sp. nov.

Figs 12f, 14, 53

MATERIAL EXAMINED. — **Japan**. *Izu Islands*. Hyotan-se Bank, 34°20.75'N, 139°20.00'E, 275-350 m, T. KOMAI coll., 15.10.1997: 1 ♂ 8.2 x 10.0 mm paratype (CBM-ZC 4625).

Philippine Islands. MUSORSTOM 2: stn CP 15, 13°55.1'N, 120°28.4'E, 326-330 m, 2.11.1980: 1 ♀ 9.9 x 11.9 mm (MNHN-B 26697). — Stn CP 83, 13°55.2'N, 120°30.5'E, 320 m, 2.12.1980: 1 ♀ (MNHN-B 26820).

Indonesia. *Kai Islands*. KARUBAR: stn DW 14, 05°18'S, 132°38'E, 245-246 m, 24.10.1991: 1 ♂ feminized by sacculinid (MNHN-B 26821). — Stn DW 32, 05°47'S, 132°51'E, 170-206 m, 26.10.1991: 1 ♀ (MNHN-B 26822).

Tanimbar Islands. KARUBAR: stn CP 46, 08°01'S, 132°51'E, 271-273 m, 29.10.1991: 1 ♂ holotype 8.4 x 10.8 mm (MNHN-B 26695).

Vanuatu. MUSORSTOM 8: stn DW 977, 19°24.89'S, 169°28.61'E, 410-505 m, 22.09.1994: 1 ♂ paratype 7.3 x 9.0 mm (MNHN-B 26696).

Fiji. BORDAU 1: stn Dw 1448, 16°45'S, 179°59'E, 410-500 m, 4.03.1999: 1 ♂, 4 ♀ (MNHN-B 27132). — Stn DW 1465, 18°09'S, 178°39'W, 290-300 m, 6.03.1999: 1 ♂ 7.8 x 9.4 mm (MNHN-B 27134).

TYPES. — *Holotype*: 1 ♂ 8.4 x 10.8 mm, KARUBAR, stn CP 46 (MNHN-B 26695).

Paratypes: 1 ♂ 7.3 x 9.0 mm, MUSORSTOM 8, stn DW 977 (MNHN-B 26696); 1 ♂ 8.2 x 10.0 mm, Hyotan-se Bank, Japan (CBM-ZC 4625); 1 ♀ paratype 9.9 x 11.9 mm, MUSORSTOM 2, stn CP 15 (MNHN-B 26697).

TYPE LOCALITY. — Tanimbar Islands, Indonesia, 08°01'S, 132°51'E, 271-273 m.

DIAGNOSIS. — Carapace (Figs 12f, 14a) transversely subovate with three anterolateral teeth on each side; teeth (rounded or slightly pointed upward in shape) decrease posteriorly in size. Dorsal surface covered by large granules

Source : MNHN, Paris

and several granular bosses, some rounded, high, particularly two on branchial region close to border of carapace; branchial region slightly inflated; posterior border with 4-6 elongate, curved tubercles, giving border sinuous appearance. Supraorbital borders each with one short, rectangular inner lobe; short, rounded outer lobe. Suborbital borders (Fig. 14b) each with high, narrow inner lobe; high, rounded outer lobe. Dorsal borders of cheliped propodi with rounded or pointed tubercles. Dactyli of walking legs (P2-4) very slender (P4 0.3-0.4 CL), with posterior borders entire (Fig. 14c). Abdomen of mature males with all segments free, one complete transverse ridge along segments 1-3, incomplete ridge along segment 4. Male first pleopods (Figs 14d-e) with sinuous basal parts; each distal part dorsoventrally flattened, with tubercle on ventral side, long row of teeth along outer edge (shorter row on inner edge). Abdomen of mature females with all segments free, one complete transverse ridge along each segment 1-4.

DESCRIPTION. — Carapace (Figs 12f, 14a) transversely subovate, wider than long (CW/CL = 1.2-1.3); dorsal surface covered with small granules and granular bosses (conspicuous and high are two rounded bosses on each branchial region along anterolateral borders, 2-3 similar bosses on center and upper border of each branchial region, two elongate bosses on metagastric region flanked by one rounded boss on each side, and one elongate boss on intestinal region immediately above the posterior border of carapace). Anterolateral borders of carapace each with three rounded or slightly pointed teeth decreasing posteriorly in size. Branchial region slightly inflated. Posterior border with 4-6 elongate, curved tubercles (giving border sinuous appearance), scattered plumose setae.

Frontal border of carapace divided into four narrow, rounded lobes (inner lobes narrower, much longer). Two conspicuous, broadly rounded bosses behind outer lobes. Borders between frontal lobes and supraorbital borders folded upward, rounded or slightly pointed medially, ending in sharp angle, forming V-shaped fissure before supraorbital border. Supraorbital borders each with one short, rectangular inner lobe; short, rounded outer lobe. Postorbital angles short (extending two-thirds of dorsal border of retracted eye), slightly narrower proximally, pointed. Cornea of eyes dorsoventrally flattened, wider than base of short eye peduncle; each peduncle with two granular tubercles on distal border.

Suborbital borders (Fig. 14b) each with high, narrow, inner lobe; high, rounded, outer lobe only slightly lower than postorbital angle. Pterygostomial lobes project ventrally, forming flat, semicircular structure posterior to each inner suborbital lobe.

Each basal antennal segment slender, rectangular (slightly pointed distal border in ventral view); flagellum long, with few, simple setae. Epistome vertically inclined, with two triangular median teeth with slightly rounded tips, each flanked by triangular, narrow, pointed outer process and thin, rounded margin before pterygostomial lobe. Inner border of ischia of third maxillipeds straight; surface coarsely granular, upper borders rounded. Meri much narrower than ischia; upper lobes broadly rounded.

Outer borders of cheliped propodi each with 3-4 rows of rounded tubercles (more pronounced in small cheliped). Fingers of largest cheliped with 3-4 broadly rounded teeth, 4-8 rounded to triangular teeth (or none) in smallest cheliped. Carpi short, outer borders with several low, rounded tubercles; meri slender, each with one row of conspicuous rounded tubercles (distalmost one more salient) and other rounded tubercles throughout.

First three pairs of walking legs (P2-4; Fig. 12f) flattened. Upper and lower borders of meri with tubercles of different sizes and shapes (mostly rounded, some pointed; smaller in P2); distalmost tubercle on each anterior border much wider at base, much higher, slender, pointed or rounded, directed distally. Carpi of walking legs (P2-4) elongate; borders of propodi and dactyli (Fig. 14c) entire. Each P2 with one dorsal, 1-2 ventral rows of tubercles on merus; two dorsal, 1-2 ventral carinae on carpus; one dorsal, two ventral carinae on propodus; one dorsal, one ventral carinae on dactylus. Each P3 with 1-2 dorsal rows of tubercles on merus (very low in some specimens); two dorsal, one ventral carinae on carpus; two dorsal, two ventral carinae on propodus; one dorsal, two ventral carinae on dactylus. Each P4 with two dorsal, one ventral (very low) rows of tubercles on merus; two dorsal, two ventral carinae on carpus; one dorsal, one ventral carinae on propodus; one dorsal, two ventral carinae on dactylus. Meri, carpi, and propodi of all walking legs with scattered plumose setae; dorsal surfaces of propodi and dactyli of P3-4 each with one row of conspicuous plumose setae along anterior borders.

First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair shorter than second. Fifth pair of pereopods (P5) short (0.8-0.9 CL); each merus very slender, surface with microscopic tubercles, many microscopic teeth, plumose setae along posterior border; each propodus with many microscopic

Source : MNHN, Paris

teeth, 0-3 short spines, plumose setae along posterior border; each dactylus with 2-9 thick spines (thicker distally) along posterior border, 1-5 small spines along anterior border, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.2-1.3	2.2	2.0-2.1	0.8-0.9
Merus length/CL	0.4-0.5	0.7	0.6	0.2-0.3
Dactylus length/Cl	0.2-0.3	0.4	0.3-0.4	0.2

Abdomen of mature males with all segments free. One complete transverse ridge along each segment 1-3; low, incomplete ridge along most of segment 4. Male first pleopods (Figs 14d-e) with sinuous basal parts; each distal part dorsoventrally flattened, with tubercle on ventral side, long row of teeth along outer edge, shorter row on inner edge.

Abdomen of mature females with all segments free. One transversal ridge along each segment 1-4.

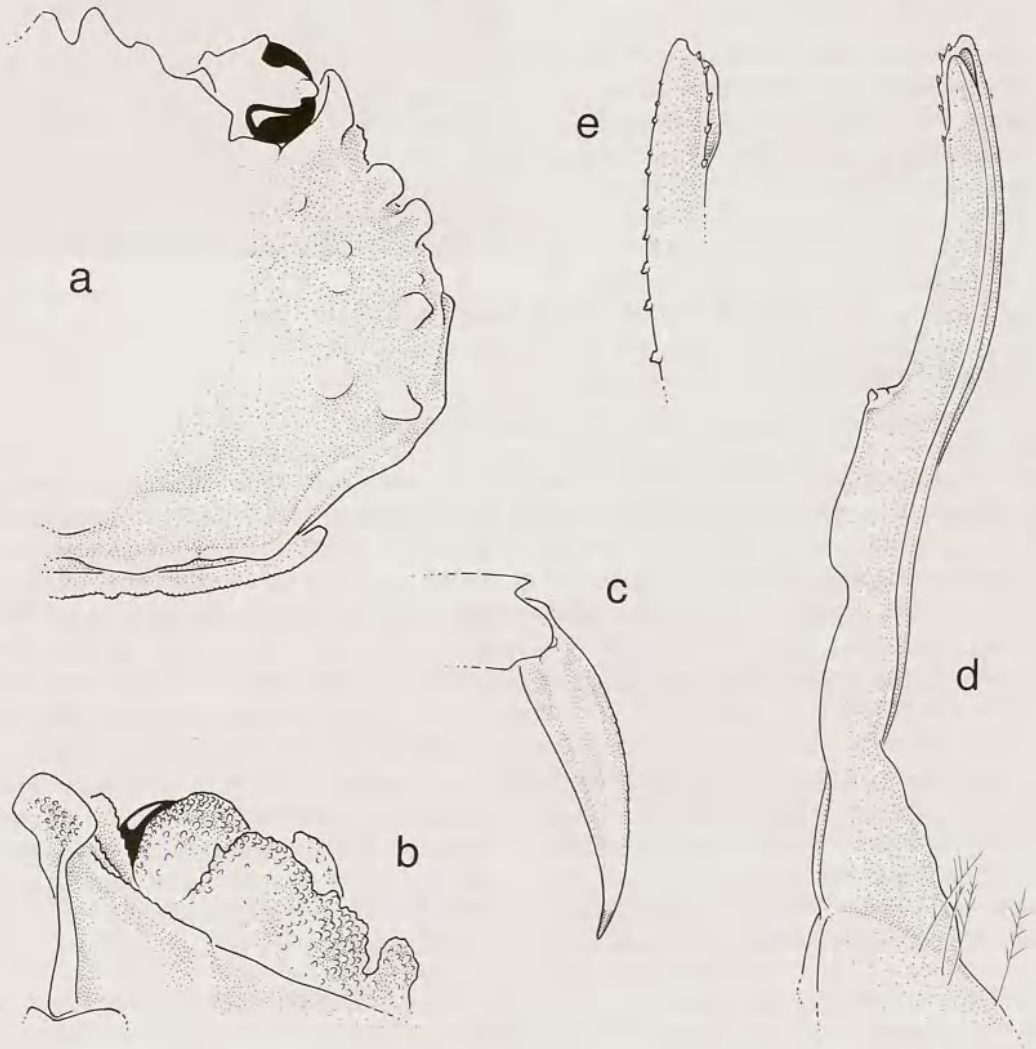


FIG. 14. — *Pseudopalicus undulatus* sp. nov., ♂ holotype 8.4 x 10.8 mm, Tanimbar Islands, Arafura Sea, Indonesia, KARUBAR, stn CP 46, 271-273 m (MNHN-B 26695): **a**, carapace, dorsal surface; **b**, suborbital border; **c**, dactylus, right fourth pereopod, dorsal view; **d**, left male first pleopod, lateral (outer side) view; **e**, left male first pleopod, apex, lateral (inner side) view.

Source : MNHN, Paris

DISCUSSION. — Diagnostic for *P. undulatus* is the presence of only three anterolateral teeth in contrast to four in most other known species of *Pseudopalicus*, although in some of these species the last tooth may be very small in some specimens. *P. undulatus* and *P. macromeles* are exceptional in the genus for having only three conspicuous anterolateral teeth. Also diagnostic for *P. undulatus* is the presence of conspicuously unequal supraorbital lobes, the inner lobe being short and the outer higher and rounded. The branchial region is slightly higher (in part accentuated by the three high bosses on its surface) than in other species of *Pseudopalicus* so that the carapace has a transversely subovate appearance (Fig. 12f) rather than the more hexagonal appearance characteristic of the genus.

More significant than these characters are the unusual male first pleopods. The basal parts are strongly sinuous (although not helicoidal as in *Parapalicus*) and a tubercle is present on each median, ventral surface. *P. macromeles* has male first pleopods with strongly sinuous basal parts (Fig. 13d); those of *Rectopalicus amphiceros* sp. nov. also have a median tubercle (Fig. 35d). The distal ends were thin, straight, and obliquely oriented in an inner direction in a small, perhaps juvenile male from Fiji (7.8 x 9.4 mm; MNHN-B 27134).

SIZE. — Maximum size among specimens examined: 9.9 x 11.9 mm (female, MNHN-B 26697); 8.4 x 10.8 mm (male, MNHN-B 26695).

ETYMOLOGY. — From *unda*, Latin for wave, in reference to the wavy appearance of the posterior border of the carapace due to the presence of elongate and curved tubercles along the margin.

DISTRIBUTION. — Japan, South China Sea (off the Philippine Islands), Banda and Arafura seas (Indonesia), Coral Sea (Vanuatu) and Fiji (Fig. 53). Depth: known reliably between 206 and 410 m; also collected in trawls between 170-206 and 410-505 m.

Genus ***PARAPALICUS*** Moosa & Serène, 1981

Parapalicus Moosa & Serène, 1981: 25.

TYPE SPECIES: *Palicus trituberculatus* Chen, 1981. Gender: masculine

DIAGNOSIS. — Frontal border of carapace divided into two small lobes (sometimes secondarily notched). Anterolateral borders each with one triangular or rounded tooth. Dorsal surface of carapace typically with small granules and high granular bosses. Eyes dorsoventrally flattened; peduncles with small, typically soft tubercles. Supraorbital borders each with one or two notches but no conspicuous lobes. Suborbital borders each typically with two dentiform lobes; outer lobe, if present, smaller than inner lobe. Each basal antennal segment slightly expanded distally (scale-like). Epistome expanded dorsoventrally; thin carina-like process along median portion without protruding median teeth. Chelipeds small, propodi and fingers slender; equal or nearly equal in males and females. First three pairs of walking legs (P2-4) very slender, with elongate meri and filiform (long, very narrow) propodi and dactyli. First pair (P2) much shorter than second and third pairs (P3-4); third pair slightly shorter or about as long as second pair. Borders of meri of P2-4 with equal or nearly equal tubercles; carpi entire, without teeth (tubercles rare); propodi and dactyli entire. Fifth pair of pereopods (P5) reduced (0.8-0.9 CL) and very slender. Abdomen of mature males triangular, with segments 3-5 fused into segment much wider than segment 6 and telson; typically two tubercles on segment 3, one on 4. Male first pleopods short; basal parts helicoidal; each distal part with one blade-like process or helicoidal pointed tips. Abdomen of mature females with segments 3-5 fused; typically one complete or reduced transverse ridge along each segment 1-4.

REDESCRIPTION. — Carapace transversely subovate, broader than long, conspicuously covered with granules of varying size, often grouped in clusters forming bosses. Anterolateral borders of carapace each with one typically conspicuous, triangular or rounded, tooth, below which carapace slightly rounded. Confluence of branchial and esogastric regions depressed, smooth; sulcus between hepatic and branchial regions. Thoracic sternite 7 with conspicuous, protuberant process (episternal process) at each outer edge posterior to insertion of fifth pair of pereopods (P5), visible dorsally as rounded or oblong process below posterolateral border of carapace.

Source : MNHN, Paris

Frontal border divided into two small lobes (sometimes secondarily notched). Supraorbital borders each with one or two notches but no conspicuous lobes. Postorbital angles short, slightly pointed or rounded tips. Cornea of eyes dorsoventrally flattened, much wider than base of eye peduncle (reniform); peduncles with small, soft or granular tubercles. Orbits deep.

Suborbital borders each typically with two pointed or rounded, dentiform lobes; outer lobe, if present, smaller than inner lobe. Pterygostomial lobe at each anterolateral angle of buccal frame projects ventrally, rounded to pointed in shape.

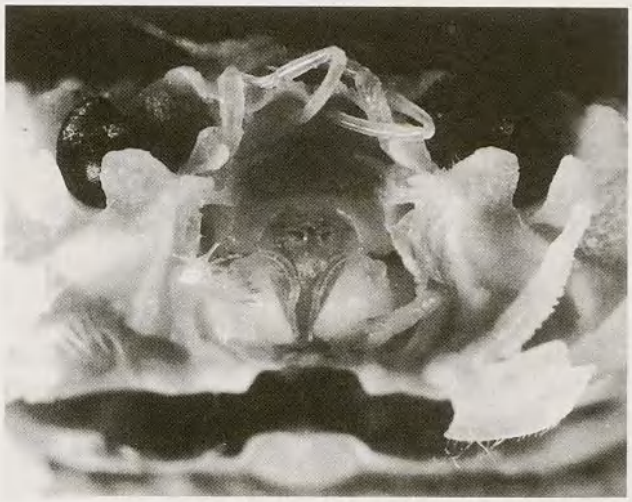


FIG. 15. — *Parapalicus clinodentatus* sp. nov., ♀ 8.6 x 12.2 mm, off southeast coast of New Caledonia, BATHUS 2, stn CP 742, 340-470 m (MNHN-B 26753): epistome.

Each basal antennal segment slightly expanded distally (scale-like); flagellum long with conspicuous setae. Epistome (Fig. 15) expanded dorsoventrally, forming broad, nearly flat surface between antennular fossae and anterior border of endostome; no median teeth, only low, thin, carina-like process along median portion flanked on each side by an outer process connecting with pterygostomial lobe. Meri of third maxillipeds smaller and narrower than ischia.

Chelipeds small, equal or nearly equal in males and females. Cheliped propodi slender; dorsal borders with small teeth or tubercles, or smooth; fingers with pointed tips, typically with triangular or rounded distal teeth. First three pairs of walking legs (P2-4) very slender, with elongate meri and filiform (long and very narrow) propodi and dactyli. Upper and lower borders of meri with equal or nearly equal tubercles; carpi entire, without teeth (tubercles rare); borders of propodi and dactyli entire. First pair of walking legs (P2) much shorter and slender than second and third pairs (P3-4); third pair slightly shorter or about as long as second pair. Last two pairs of walking legs (P3-4) each with rounded coxae, having rounded (not expanded, thin-edged) anterior and posterior borders. Fifth pairs of pereopods (P5) reduced (0.8-0.9 CL) and very slender; basis-ischia slender, smooth; few spines along posterior border of dactyli, sometimes on propodi.

Abdomen of mature males with segments 1-2 dorsoventrally compressed, 3-5 fused (but traces of sutures usually visible) into segment much wider than segment 6 and telson, giving abdomen triangular appearance. Typically two tubercles on segment 3, one on 4. Telson with fine granules. Male first pleopods short; basal parts helicoidal, each distal part with one blade-like process or helicoidal pointed tips. Second male pleopods short, thin, slightly curved; distal segment with blunt tip.

Abdomen of mature females broad, rounded, segments 1-2 dorsoventrally compressed, 3-5 fused (but traces of suture usually visible), typically one complete or reduced transverse ridge along each segment 1-4. Abdomen of immature females triangular (but broader than in males), segments 1-2 dorsoventrally compressed, 3-5 or 3-6 fused, transverse ridge along each segment 1-4.

SPECIES INCLUDED. — There are 13 known species of *Parapalicus*, by alphabetical order: *P. ambonensis* Moosa & Serène, 1981, *P. armatus* sp. nov., *P. clinodentatus* sp. nov., *P. denticulatus* sp. nov., *P. elaniticus* (Holthuis, 1977), *P. inanis* sp. nov., *P. inermis* sp. nov., *P. microphthalmus* sp. nov., *P. nanshaensis* Dai & Xu, 1991, *P. piruensis* Moosa & Serène, 1981, *P. trispiralis* sp. nov., *P. trituberculatus* (Chen, 1981), *P. unidentatus* (Zarenkov, 1968).

SEXUAL DIMORPHISM. — There is only a marked difference in size, females being much larger. The chelipeds are equal or almost equal in size in both males and females. There is no evidence of differences in the length or shape of the walking legs or fifth pair of pereopods.

Source : MNHN, Paris

DISCUSSION. — *Parapalicus* is a relatively homogenous genus described by MOOSA and SERÈNE (1981) to include seven species, two of which are now placed in other genera. The description of 10 additional species (eight here) and the description of new genera, however, necessitates the addition of characters to the brief original definition.

In defining the genus and separating it from other genera of palicids, MOOSA and SERÈNE (1981: 24, 25) described the first pair of walking legs (P2) of *Parapalicus* as "much slenderer" than the remaining two pairs in contrast to the other three genera of the subfamily Palicinae they described, where the first pair is only "a little smaller" than the remaining pairs. This is misleading since, although in *Parapalicus* the second pair is slightly more slender (that is, narrower) than the other legs, there is actually no difference in the total length between the genera.

The long, slender legs and general carapace shape of *Parapalicus* are closer to RATHBUN's group 2 of the western Atlantic species of *Palicus* Philippi, 1838 (RATHBUN, 1918: 184): *P. acutifrons* (A. Milne Edwards, 1880), *P. cursor* (A. Milne Edwards, 1880), *P. floridanus* (Rathbun, 1918), *P. gracilis* (Smith, 1883), and *P. gracilipes* (A. Milne Edwards, 1880). None of these five species fully agree with the characters used in the definition of *Parapalicus* and the other Indo-west Pacific genera of palicids. Nevertheless, ZARENKOV (1968) placed his species, *Parapalicus unidentatus* (Zarenkov, 1968), under group 1 of RATHBUN. He suggested that several species had independently evolved the long legs of group 2 as a specialization for greater depths (ZARENKOV, 1968: 766).

The three western Atlantic species placed by RATHBUN (1918: 184) in her group 4 [*P. angustus* Rathbun, 1897, *P. depressus* Rathbun, 1897, and *P. sica* (A. Milne Edwards, 1880)] are characterized by a structure ("broad, projecting plates of abdomen and sternum which are conspicuous in dorsal view"; "laminate crest projecting behind third and fourth walking legs" in WILLIAMS, 1984: 484) that is analogous, and perhaps homologous, to the episternal process of *Parapalicus*. None of these Atlantic species, however, have the very slender walking legs with filiform propodi and dactyli, the single anterolateral tooth on each side of the carapace, and the dentiform suborbital lobes diagnostic of *Parapalicus*.

All known species of *Parapalicus* appear to be restricted to muddy sediments in the Indo-west Pacific region. They have been collected at depths of 55-778 m. Recently dredged, live specimens have been observed to slide over sediment by using their long and slender walking legs (B. RICHER DE FORGES, personal communication).

MOOSA and SERÈNE (1981) designated *P. marielae* Moosa & Serène, 1981 as the type species of their new genus *Parapalicus*. It has been found to be a junior subjective synonym of *P. trituberculatus* (Chen, 1981) (see below). The type species is now fixed (under Article 70.3 of the International Code of Nomenclature, fourth edition, 1999) as *Parapalicus trituberculatus* (Chen, 1981) misidentified as *Parapalicus marielae* Moosa & Serène, 1981 in the original designation of MOOSA & SERÈNE (1981).

Key to the species of *PARAPALICUS*

1. Dactyli of chelipeds with blunt teeth closed together at tip of fingers (DAI & XU, 1991, fig. 28-4) ..... ***P. nanshaensis*** Dai & Xu, 1991
— Dactyli of chelipeds with triangular teeth extending along two-thirds to one-half (rarely one-third) of fingers **2**

2. Dorsal border of cheliped propodi with conspicuous, pointed tubercles (Fig. 17c). Outer border of carpi of walking legs (P2-4) with conspicuous pointed tubercles (Fig. 17a) ..... ***P. armatus*** sp. nov.
— Dorsal border of cheliped propodi smooth, with minute teeth, or two rounded, proximal tubercles. Outer border of carpi of walking legs (P2-4) smooth or with microscopic tubercles **3**

3. Only one suborbital lobe, leaving straight border between tooth-like inner lobe and postorbital angle (Fig. 23b) ..... ***P. inanis*** sp. nov.
— Two dentiform suborbital lobes before postorbital angle **4**

Source : MNHN, Paris

4. Gap between inner and outer suborbital lobe long, narrow, V-shaped **5**
— Gap between inner and outer suborbital lobes wide, U-shaped, or short when outer lobe much smaller than outer lobe **6**

5. Anterolateral tooth on side of carapace rounded, bent at slight angle in relation to carapace (Figs 18a, 19c) ..... ***P. clinodentatus*** sp. nov.
— Anterolateral tooth on side of carapace triangular (ZARENKOV, 1968, fig. 3A) ..... ***P. unidentatus*** (Zarenkov, 1968)

6. Dorsal border of cheliped propodus with two proximal tubercles **7**
— Dorsal border of cheliped propodus smooth or with microscopic teeth **8**

7. Rounded tubercle on distal edge of supraorbital border and proximal to postorbital angle, giving angle bilobed appearance (HOLTHUIS, 1977, fig. 3a) ..... ***P. elaniticus*** (Holthuis, 1977)
— Supraorbital angle without conspicuous, distal tubercle proximal to postorbital angle ..... ***P. ambonensis*** sp. nov.

8. Outer suborbital lobe very small, less than one-third as long as inner suborbital lobe ... **9**
— Outer suborbital lobe at least one-half as long as inner suborbital lobe **10**

9. Supraorbital border sinuous, with two notches but no lobes. Dorsal borders of cheliped propodi smooth ..... ***P. piruensis*** Moosa & Serène, 1981
— Supraobital border with two very small lobes (Fig. 27a). Dorsal borders of cheliped propodi with microscopic teeth (Fig. 27c) ..... ***P. trispiralis*** sp. nov.

10. Inner suborbital lobes narrow, pointed, bordered by pointed tubercles (Fig. 24b). Male first pleopods with helicoidal distal ends (Figs 24d-e). Eyes narrow, small (Fig. 24a) ..... ***P. microphthalmus*** sp. nov.
— Inner suborbital lobes not narrow, with rounded tips. Male first pleopods with simple, blade-like distal ends. Eyes not narrow **11**

11. Eye peduncles covered with small, granular tubercles. Gap between inner and outer suborbital lobes very broad, nearly circular (CHEN, 1981, pl. 2, fig. 1) ..... ***P. trituberculatus*** (Chen, 1981)
— Eye peduncles covered with few, soft tubercles. Gap between inner and outer suborbital lobes broad but V- or L-shaped (Figs 20b, 22b) **12**

12. Dorsal borders of cheliped propodi with rows of microscopic teeth (Fig. 20c). Trigger-like process at proximal portion of distal part of male first pleopods (Fig. 20e) ..... ***P. denticulatus*** sp. nov.
— Dorsal borders of cheliped propodi with barely visible microscopic teeth (Fig. 22c). Proximal portion of distal parts of male first pleopods smooth, without process (Fig. 22e) ..... ***P. inermis*** sp. nov.

Parapalicus ambonensis Moosa & Serène, 1981

Figs 16, 19a, 58

Parapalicus ambonensis Moosa & Serène, 1981: 29, figs 2a, 3a, pl. 1, fig. D.

MATERIAL EXAMINED. — **Thailand** *(Andaman Sea coast)*. Off Phuket Island. Stn 8, 80 m, triangular dredge, 18.02.1998: 1 ♀ (PMBC).

Indonesia. *Haruku Island.* MARIEL KING MEMORIAL EXPEDITION: stn AH I/4, north of Cape Batang Kapal, 03°36'S, 128°24'E, shell sand and rubble, 110-115 m, 31.05.1970: 1 ♀ holotype 5.4 x 7.6 mm (RDC CB2733).

Source : MNHN, Paris

Kai Islands. KARUBAR: stn DW 29, 05°36'S, 132°56'E, 181-184 m, 26.10.1991: 1 ♂ (MNHN-B 26963).

Vanuatu. MUSORSTOM 8: stn CP 963, 20°20.10'S, 169°49.08'E, 400-440 m, 21.09.1994: 2 ♀ (MNHN-B 27078). — Stn CP 971, 20°18.87'S, 169°53.12'E, 250-315 m, 21.09.1994: 1 ♂ (MNHN-B 27079). — Stn CP 1017, 17°52.80'S, 168°26.20'E, 294-295 m, 27.09.1994: 1 ♂, 2 ♀ (MNHN-B 27080). — Stn CP 1018, 17°52.88'S, 168°25.08'E, 300-301 m, 27.09.1994: 1 ♀ (MNHN-B 27081). — Stn CP 1086, 15°36.58'S, 167°16.32'E, 182-215 m, 5.10.1994: 1 ♀ 6.3 x 8.7 mm (MNHN-B 26707), 1 ♂ 5.1 x 7.2 mm (MNHN-B 26708), 1 ♂, 1 ♀ (MNHN-B 27082). — Stn DW 1093, 15°10.91'S, 167°11.19'E, 275 m, 6.10.1994: 1 ♂ 5.2 x 7.4 mm (MNHN-B 26709). — Stn DW 1097, 15°05.13'S, 167°10.76'E, 281-288 m, 7.10.1994: 2 ♂ (MNHN-B 27083). — Stn CP 1102, 15°03.82'S, 167°08.68'E, 210-208 m, 7.10.1994: 1 ♀ (MNHN-B 27084). — Stn CP 1134, 15°39.94'S, 167°02.79'E, 230-287 m, 11.10.1994: 1 ♀ (MNHN-B 27085). — Stn CP 1135, 15°40.50'S, 167°02.43'E, 282-375 m, 11.10.1994: 3 ♀ (MNHN-B 27086).

Chesterfield-Bellona Plateau. CHALCAL 1: stn CP 11, 20°04.40'S, 158°47.41'E, 300 m, 07.1984: 1 ♂ (MNHN-B 26964).

MUSORSTOM 5: stn 345, 19°39.70'S, 158°32.40'E, 305-310 m, 16.10.1986: 1 ♂, 1 ♀ (MNHN-B 27087).

New Caledonia. MUSORSTOM 4: Grand Passage, stn 173, 19°02.50'S, 163°18.80'E, 250-290 m, 17.09.1985: 1 ♂ 5.2 x 7.3 mm (MNHN-B 26706).

"Kandjar", dredging between 22°40'-22°50'S and 167°10'-167°30'E, 200-350 m, 7-10.10.1986: 1 ♀ (MNHN-B 26966).

BATHUS 1: stn DW 640, 21°52.33'S, 166°47.93'E, 174 m, 10.03.1993: 1 ♀ (MNHN-B 27088). — Stn CP 713, 21°45.28'S, 166°36.83'E, 250 m, 19.03.1993: 1 ♀ (MNHN-B 27089).

BATHUS 3: stn DW 836, 23°02'S, 166°59'E, 295-306 m, rocks and gravel, 30.11.1993: 1 ♂, 2 ♀ (MNHN-B 27090).

BATHUS 4: stn DW 901, 19°02.72'S, 163°15.39'E, 297 m, 4.08.1994: 3 ♀ (MNHN-B 27091). — Stn CP 905, 19°02'S, 163°15'E, 294-296 m, 4.08.1994: 3 ♂, 11 ♀ (MNHN-B 26754).

Loyalty Islands. MUSORSTOM 6: stn CP 419, 20°41.65'S, 167°03.70'E, 283 m, 16.02.1989: 1 ♂ (MNHN-B 27092). — Stn DW 452, 21°00.30'S, 167°25.50'E, 300 m, 20.02.1989: 1 ♀ (MNHN-B 27093). — Stn DW 462, 21°05.10'S, 167°26.85'E, 200 m, 21.02.1989: 1 ♀ 6.7 x 9.1 mm (MNHN-B 26710).

Futuna Island. MUSORSTOM 7: stn CP 515, 14°13'S, 178°10'W, 224-252 m, 12.05.1992: 1 ♀ (MNHN-B 26965).

TYPES. — *Holotype*: 1 ♀ 5.4 x 7.6 mm, MARIEL KING MEMORIAL EXPEDITION, stn AH I/4 (RDC CB2733).

TYPE LOCALITY. — North of Cape Batang Kapal, Haruku Island, Moluccas, Indonesia, 03°36'S, 128°24'E, shell sand and rubble, 110-115 m.

DIAGNOSIS. — Carapace (Figs 16a, 19a; MOOSA & SERÈNE, 1981, fig. 2a) with anterolateral tooth on each side; tooth with truncate outer border and short, rounded upper border. Small, tooth-like tubercle between anterolateral tooth and postorbital angle. Supraorbital borders each with three notches. Suborbital borders each with narrow, V-shaped gap between inner and outer suborbital lobes; outer lobe much smaller than inner lobe. Dorsal borders of cheliped propodi each with two proximal tubercles, distalmost rounded, conspicuous. Abdomen of mature males (Fig. 16b) with two triangular tubercles on segment 3 and larger one on segment 4. Male first pleopods (Fig. 16c) with helicoidal basal parts; each distal portion beak-like, with spinules along dorsal margin. Abdomen of mature females (Fig. 16d) with one transverse ridge along each segment 1-3 (segment 3 slightly constricted twice medially); short ridge at each outer edge of segment 4.

DISCUSSION. — *P. ambonensis* was until now know from only one female specimen. Only the last pair of legs was present, MOOSA & SERÈNE (1981) did not give any information on the morphology of the chelipeds or of the suborbital borders, and the only photograph given is of poor quality. The examination of the holotype (RDC CB2733) and the presence of its distinctive characters in specimens collected from the Andaman Sea to the Coral Sea confirms its status as a distinctive species. This is the first time the male first pleopod is described and illustrated.

The examination of the holotype also showed that one diagnostic character given in its description, the presence of "teeth" along the inner borders of the third maxillipeds, was a misinterpretation of the serrate nature of the borders. Although only the right maxilliped remains in the holotype, its inner border does not have separate, distinctive teeth as shown in the figure of the left maxilliped (MOOSA & SERÈNE, 1981, fig. 3a).

Other characters useful in its identification are the presence of a basal antennal segment that is expanded distally as a rounded process and a small, tooth-like tubercle between each anterolateral tooth and the postorbital angle. Its size varies, sometimes hardly visible on one side but larger on the opposite side of the same specimen.

Source : MNHN, Paris

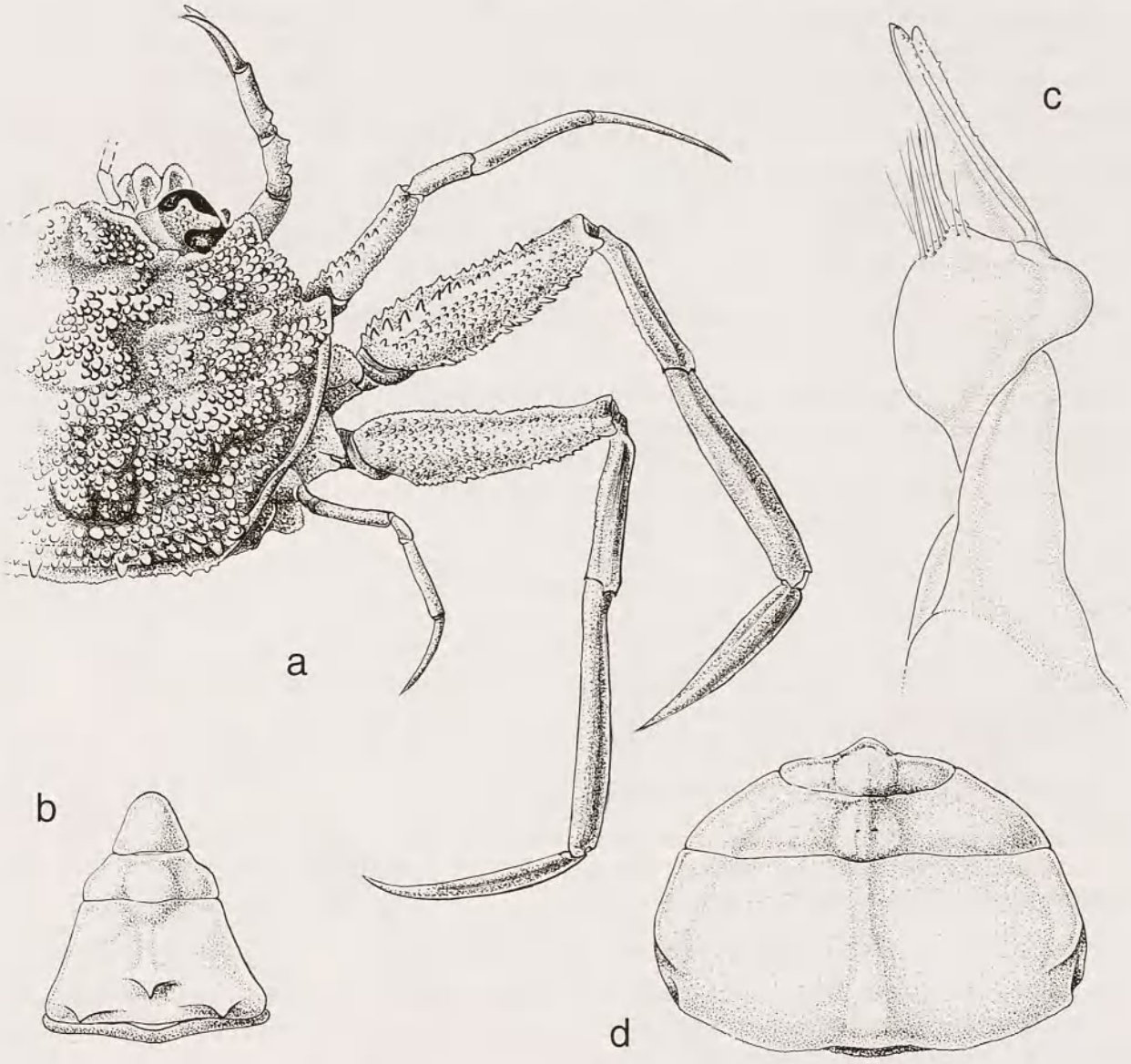


FIG. 16. — *Parapalicus ambonensis* Moosa & Serène, 1981: **a-b**, ♀ 6.3 x 8.7 mm, north of Malekula Island, Vanuatu, MUSORSTOM 8, stn CP 1086, 182-215 m (MNHN-B 26707): **a**, carapace and pereopods, dorsal surface; **b**, abdomen. — **c**, ♂ 5.2 x 7.3 mm, Grand Passage, New Caledonia, MUSORSTOM 4, stn 173, 250-290 m (MNHN-B 26706): abdomen. — **d**, ♂ 5.2 x 7.4 mm, east of Espiritu Santo Island, Vanuatu, MUSORSTOM 8, stn DW 1093, 275 m (MNHN-B 26709): left male first pleopod, ventral view.

The fifth pair of pereopods (P5) are short (0.8 CL), each merus with 3-4 small spines along the posterior border, the propodus with 4-8 spines along the posterior border, and the dactylus with 2-3 spines along the posterior border and one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.3-1.5	2.7	2.5-2.6	0.8
Merus length/CL	0.4-0.5	0.7-0.8	0.7-0.8	0.2
Dactylus length/Cl	0.4	0.6-0.7	0.6-0.7	0.2

Source : MNHN, Paris

P. ambonensis shares several features with *P. nanshaensis* Dai & Xu, 1991, a species known from only one female specimen (see below). Both species have a similar carapace shape and a cheliped merus that is armed with only two proximal tubercles. *P. nanshaensis*, however, has very characteristic blunt, closed-together teeth on the cheliped fingers (DAI & XU, 1991, fig. 28-4) and only one slight notch on each supraorbital border. The morphology of the suborbital borders, male first pleopods, and male abdomen of *P. nanshaensis* remain unknown but the holotype was not available for examination.

P. ambonensis shares with *P. armatus* sp. nov. and *P. trispiralis* sp. nov. the presence of pointed tubercles on the male abdomen. The dorsal borders of the chelipeds of these two species are armed with conspicuous tubercles (*P. armatus*) or microscopic teeth (*P. trispiralis*).

SIZE. — Maximum size among specimens examined: 6.3 x 9.7 mm (female, MNHN-B 26754); 5.5 x 7.3 mm (male, MNHN-B 26754).

DISTRIBUTION. — Known from the Andaman Sea (off Phuket island, Thailand), Banda Sea (off Kai Islands, Indonesia), Haruku Island (near Ambon, Indonesia) (MOOSA & SERÈNE, 1981), Coral Sea (Vanuatu, Chesterfield-Bellona Plateau, New Caledonia, and the Loyalty Islands), and Futuna Island, southwestern Pacific (Fig. 58). Depth: known reliably between 80 and 400 ; also collected in a trawl between 400 and 440 m.

Parapalicus armatus sp. nov.

Figs 17, 19b, 57

MATERIAL EXAMINED. — **Vanuatu**. — MUSORSTOM 8: stn CP 963, 20°20'S, 169°49'E, 400-440 m, 21.09.1994: 1 ♂ holotype 6.5 x 9.0 mm (MNHN-B 26698).

Loyalty Islands. — MUSORSTOM 6: stn DW 457, 21°00.42'S, 167°28.71'N, 353 m, 20.02.1989: 1 ♂ paratype 6.5 x 8.7 mm (MNHN-B 26699). — Stn CB 481, 21°21.85'S, 167°50.30'E, 300 m, 23.02.1989: 1 ♀ paratype 8.1 x 10.6 mm (MNHN-B 26700), 1 ♂, 2 ♀ (MNHN-B 26823).

TYPES. — *Holotype:* 1 ♂ 6.5 x 9.0 mm, MUSORSTOM 8, stn CP 963 (MNHN-B 26698).

Paratypes: 1 ♂ 6.5 x 8.7 mm, MUSORSTOM 6, stn DW 457 (MNHN-B 26699); 1 ♀ 8.1 x 10.6 mm, MUSORSTOM 6, stn CB 481 (MNHN-B 26700).

TYPE LOCALITY. — Off south coast of Aneityum (Anatom) Island, Vanuatu, 20°20'S, 169°49'E, 400-440 m.

DIAGNOSIS. — Carapace (Figs 17a, 19b) with small, triangular anterolateral tooth on each side; conspicuous tubercles along posterior border. Supraorbital borders each with three notches. Suborbital borders (Fig. 17b) each with narrow, V-shaped gap between inner and outer suborbital lobes; outer lobe rounded. Dorsal borders of cheliped propodi (Fig. 17c) each with 3-4 rows of pointed tubercles. Meri of second and third pairs of walking legs (P3-4) with tubercles along upper and lower edges. Abdomen of mature males (Fig. 17d) with two triangular tubercles on segment 3, similar one on segment 4. Male first pleopods (Figs 17e-f) with helicoidal basal parts; each distal part long, blade-like, rising from thickened portion of basal part. Abdomen of mature females with one transverse ridge along each segment 1-3 (segment 3 slightly constricted twice medially); segment 4 with short ridge at outer edges.

DESCRIPTION. — Carapace (Figs 17a, 19b) wider than long (CW/CL = 1.3-1.4); dorsal surface covered with coarse granules. Anterolateral borders of carapace each with very small triangular tooth covered with fine granules. Two small, low bosses, also covered with granules, on branchial region posterior to each tooth. Larger females with four conspicuous bosses (two large median lobes flanked by smaller one on each side) on metagastric region. Posterior border of carapace with 8-12 protuberant tubercles with rounded tips and many small tubercles with pointed or rounded tips. Episternal processes conspicuous, bordered by very small teeth, with anterior tubercle in some specimens. Posterior border of carapace with scattered plumose setae.

Frontal border of carapace divided into two small lobes divided by narrow V-shaped notch; triangular or slightly rounded tips. Borders between frontal lobes and supraorbital borders rounded, marked by slight undulation medially. Supraorbital borders each with three distinct notches. Postorbital angles short, slightly pointed. Cornea of eyes

Source : MNHN, Paris

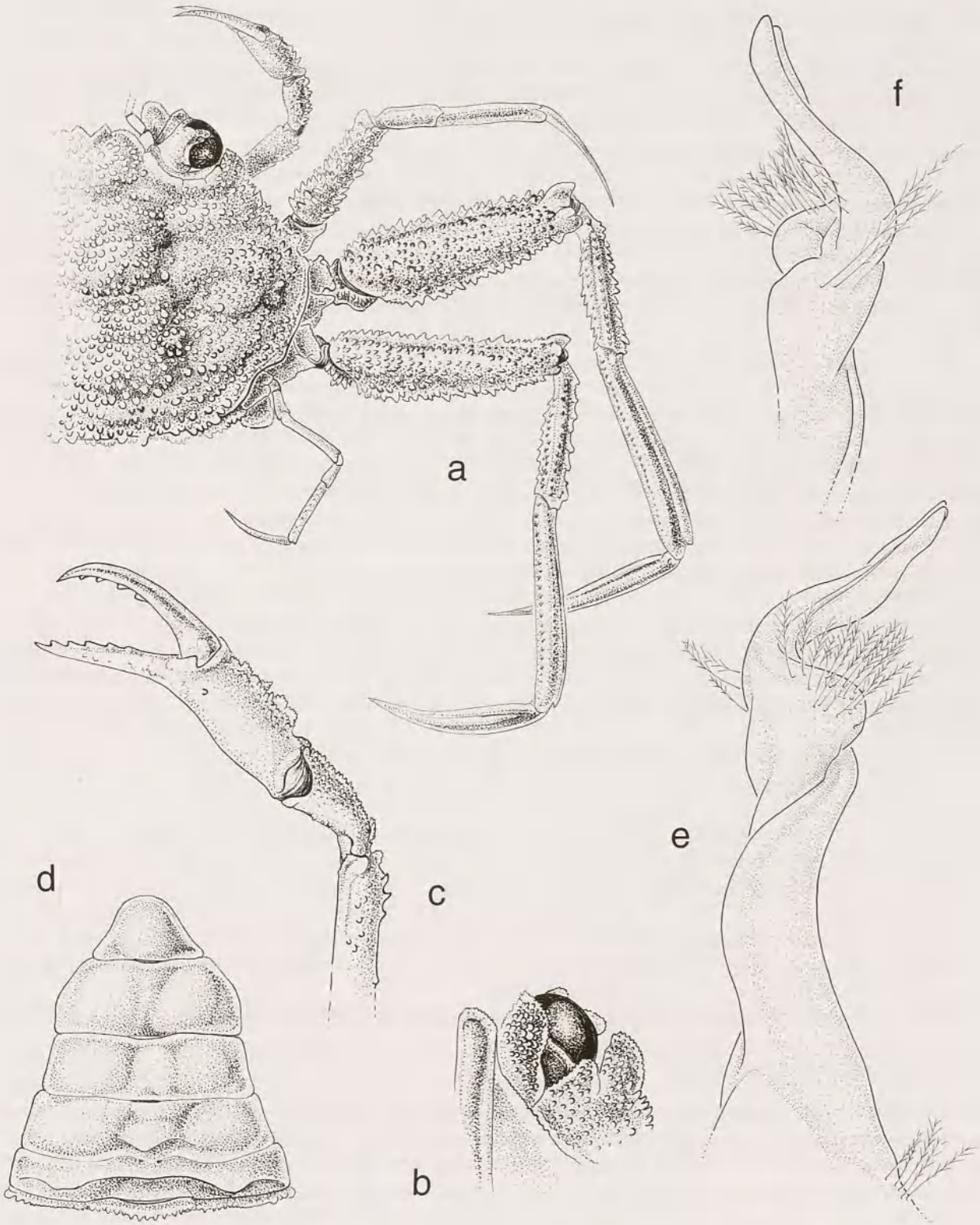


FIG. 17. — *Parapalicus armatus* sp. nov., ♂ holotype 6.5 x 9.0 mm, south of Aneityum Island, Vanuatu, MUSORSTOM 8, stn CP 963, 400-440 m (MNHN-B 26698): **a**, carapace and pereopods, dorsal surface; **b**, suborbital border; **c**, left cheliped, outer surface; **d**, abdomen; **e**, left male first pleopod, ventral view; f, left male first pleopod, distal part, lateral (inner side) view.

Source : MNHN, Paris

dorsoventrally flattened, much wider than base of short eye peduncle; each peduncle with two soft, distal tubercles (ventral largest).

Suborbital borders (Fig. 17b) each with narrow, V-shaped gap between inner and outer suborbital lobes. Outer lobe rounded, shorter than pointed inner lobe. Pterygostomial lobes project slightly ventrally, rounded (slightly pointed in some specimens), shorter than each inner suborbital lobe.

Each basal antennal segment expanded distally as rounded process; flagellum long with conspicuous, simple setae. Inner border of ischia of third maxillipeds sinuous to serrate but without defined teeth; surface coarsely granular, upper borders rounded. Meri much narrower than ischia; rounded, narrow upper borders.

Dorsal and outer borders of cheliped propodi (Fig. 17c) each with 3-4 rows of conspicuous tubercles, those of uppermost row with pointed or broadly acute tubercles (more conspicuous in males). Distal two-thirds of each finger with 4-5 triangular teeth (shorter in some specimens). Carpi short, outer borders with conspicuous, broad tubercle across distal portion and pointed tubercles throughout; meri slender, outer border with pointed tubercles.

First three pairs of walking legs (P2-4; Figs 17a, 19b) very slender, with elongate meri and filiform propodi and dactyli. Upper and lower borders of meri with small, similarly pointed tubercles (smaller on P2); distalmost tubercle on each anterior border much wider at base, higher, with rounded tip directed distally. Anterior and posterior borders of carpi of second and third walking legs (P3-4) with rounded tubercles; borders of propodi and dactyli of all walking legs (P2-4) entire (propodi of P3-4 with microscopic tubercles, proximal portion with visible tubercles, particularly P4). Each P2 with one dorsal carina each on carpus and dactylus. Each P3 with one dorsal carina on merus; two dorsal carinae on carpus; one dorsal, one ventral carina each on propodus and dactylus. Each P4 with two dorsal carinae on carpus; one dorsal and one ventral carina each on propodus and dactylus. Meri of all legs with scattered plumose setae; dorsal surface of carpi and propodi of P3-4 with rows of plumose setae; dorsal surfaces of dactyli of P3-4 each with one row of conspicuous plumose setae along anterior border.

First pair of walking legs (P2) much shorter and slender than second and third pairs (P3-4); third pair about as long as second pair. Fifth pair of pereopods (P5) short (0.8 CL), very slender; each merus with several tubercles, 3-4 spines, scattered plumose setae along posterior border; each propodus with 6-8 spines along posterior border, scattered plumose setae along anterior border; each dactylus with three spines along posterior border, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.3-1.4	2.5-2.6	2.5-2.6	0.8
Merus length/CL	0.4-0.5	0.7-0.8	0.8	0.3
Dactylus length/Cl	0.3-0.4	0.6	0.6	0.2

Abdomen of mature males (Fig. 17d) with segments 3-5 fused, two triangular tubercles on segment 3, one on 4. Male first pleopods (Figs 17e-f) with helicoidal basal parts; each distal part long, blade-like rising from thickened portion of basal part, which has plumose setae.

Abdomen of mature females with segments 3-5 fused. One transversal ridge along segments 1-2, each bordered by small, pointed tubercles; segment 3 of fused segment 3-5 with ridge slightly constricted twice medially; short ridge at each outer edge of segment 4.

DISCUSSION. — *P. armatus* can be easily distinguished from the other known members of the genus by the presence of conspicuous, pointed tubercles along the dorsal surface of the cheliped propodi, the posterior border of the carapace, and on the anterior and posterior borders of the meri of walking legs. The abundance of pointed tubercles through the body and appendages give individuals a rough appearance. It shares with *P. inanis* sp. nov. a greatly reduced anterolateral tooth on each side of the carapace; with *P. ambonensis* and *P. trispiralis* sp. nov. pointed tubercles on the male abdomen.

SIZE. — Maximum size among the six specimens examined in this study: 8.1 x 10.6 mm (female paratype, MNHN-B 26700); 6.5 x 9.0 mm (male holotype, MNHN-B 26698).

Source : MNHN, Paris

ETYMOLOGY. — From *armatus*, Latin for furnished with weapons, in reference to the diagnostic pointed tubercles along the dorsal surface of the chelipeds, meri of walking legs, and posterior border of the carapace.

DISTRIBUTION. — Known only from the Coral Sea (Vanuatu and the Loyalty Islands) (Fig. 57). Depth: known reliably between 300 and 400 m; also collected in a trawl between 400 and 440 m.

Parapalicus clinodentatus sp. nov.

Figs 18, 19c, 57

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn CP 1092, 15°10.80'S, 167°12.33'E, 314-321 m, 6.10.1994: 1 ♂, 2 ♀ (MNHN-B 26954). — Stn CP 1135, 15°40.50'S, 167°02.43'E, 282-375 m, 11.10.1994: 5 ♀ (MNHN-B 26955).

New Caledonia. BIOCAL: stn CP 105, 21°30.71'S, 166°21.72'E, 330-335 m, 8.09.1985: 1 juv. ♀ (MNHN-B 28006).

BATHUS 1: stn CP 670, 20°54'S, 165°53'E, 394-397 m, 14.03.1993: 1 ♂, 1 ♀ 9.0 x 13.1 mm (MNHN-B 26752). — Stn CP 701, 20°57.54'S, 165°35.86'E, 302-335 m, 18.03.1993: 3 ♂, 4 ♀ (MNHN-B 26956). — Stn 707, 21°42'S, 166°35'E, 347-375 m, 19.03.1993: 5 ♂, 10 ♀ (MNHN-B 27000). — Stn 708, 21°43.05'S, 166°38.57'E, 550-580 m, 19.03.1993: 1 ♀ (MNHN-B 26957). — Stn CP 710, 21°43.16'S, 166°36.35'E, 320-386 m, 19.03.1993: 1 ♂ paratype 5.9 x 8.7 mm (MNHN-B 26702), 1 ♀ paratype 8.5 mm x 12.0 mm (MNHN-B 26703), 13 ♂, 9 ♀ (MNHN-B 27001). — Stn CP 711, 21°43.00'S, 166°35.57'E, 315-327 m, 19.03.1993: 3 ♂, 2 ♀ (MNHN-B 26958).

BATHUS 2: stn CP 742, 22°33.45'S, 166°25.86'E, 340-470 m, 14.05.1993: 8 ♂, 13 ♀ (MNHN-B 26753), 1 ♀ 8.6 x 12.2 mm (MNHN-B 26705), 1 ♂ paratype 5.7 x 8.6 mm, 1 ♀ paratype 8.1 x 11.3 mm (USNM), 1 ♂ paratype 7.3 x 10.6 mm, 1 ♀ paratype 8.0 x 11.3 mm (ZRC 199.1431-1432). — Stn CP 743, 22°35.56'S, 166°26.23'E, 713-950 m, 14.05.1993: 1 ♂, 1 ♀ (MNHN-B 26959). — Stn CP 756, 22°22'S, 166°13'E, 672 m, 16.05.1993: 1 ♂ paratype 6.4 x 9.3 mm (MNHN-B 26704).

HALIPRO 1: stn CP 851, 21°43'S, 166°37'E, 314-364 m, 19.03.1994: 1 ♂ holotype 6.2 x 9.0 mm (MNHN-B 26701), 5 ♂, 5 ♀ (MNHN-B 27003). — Stn CC 856, 21°44'S, 166°37'E, 311-365 m, 20.03.1994: 1 ♀ (MNHN-B 27004). — Stn 868, 21°14'S, 165°55'E, 430-550 m, 23.03.1994: 1 ♂ (MNHN-B 27005).

BATHUS 4: stn CP 897, 20°15.93'S, 163°51.75'E, 305-350 m, 3.08.1994: 1 ♂ (MNHN-B 26960). — Stn CP 899, 20°16.68'S, 163°50.26'E, 500-600 m, 3.08.1994: 1 ♀ (MNHN-B 26961). — Stn CP 946, 20°33.81'S, 164°58.35'E, 386-430 m, 10.08.1994: 1 ♂ (MNHN-B 26962).

Fiji. MUSORSTOM 10: stn 1348, 17°30.29'S, 178°39.63'E, 353-390 m, 11.08,1998: 2 ♀ (MNHN-B 26751).

BORDAU 1: stn CP 1427, 17°16'S, 179°01'W, 364-369 m, 1.03.1999: 2 ♂, 1 ♀ (MNHN-B 27135).

TYPES. — *Holotype*: 1 ♂ 6.2 x 9.0 mm, HALIPRO 1, stn CP 851 (MNHN-B 26701).

Paratypes: 1 ♂ 5.9 x 8.7 mm, BATHUS 1, stn CP 710 (MNHN-B 26702); 1 ♀ 8.5 x 12.0 mm, BATHUS 1, stn CP 710 (MNHN-B 26703); 1 ♂ 6.4 x 9.3 mm, BATHUS 2, stn 756 (MNHN-B 26704); 1 ♀ paratype 8.6 x 12.2 mm, BATHUS 2, stn CP 742 (MNHN-B 26705); 1 ♂ paratype 5.7 x 8.6 mm, 1 ♀ paratype 8.1 x 11.3 mm, BATHUS 2, stn CP 742 (USNM); 1 ♂ paratype 7.2 x 10.6 mm, 1 ♀ paratype 8.0 x 11.3 mm, BATHUS 2, stn CP 742 (ZRC 1999.1431-1432).

TYPE LOCALITY. — Off east coast of New Caledonia, 21°43'S, 166°37'E, 314-364 m.

DIAGNOSIS. — Carapace (Figs 18a, 19c) with rounded anterolateral tooth on each side; tooth posteriorly bent at a slight angle in relation to carapace. Supraorbital borders irregular, undulating, without defined notches. Suborbital borders (Fig. 18b) each with very narrow, V-shaped gap between inner and outer suborbital lobes. Dorsal borders of cheliped propodi each with carina-like row of irregular tubercles. Abdomen of mature males (Fig. 18c) with two low tubercles on segment 3, similar one on segment 4. Male first pleopods (Fig. 18d) with helicoidal basal parts; each distal part with two curved, unequal, pointed tips that cross each other. Abdomen of mature females with one transverse ridge along each segment 1-4.

Color: Specimens that were examined only nine months after collection (MNHN-B 26751) showed that some of the tubercles on the meri and carpi of the walking legs, the meri of chelipeds, and on the dorsal surface of the carapace (mostly along the anterior border) were orange.

Source : MNHN, Paris

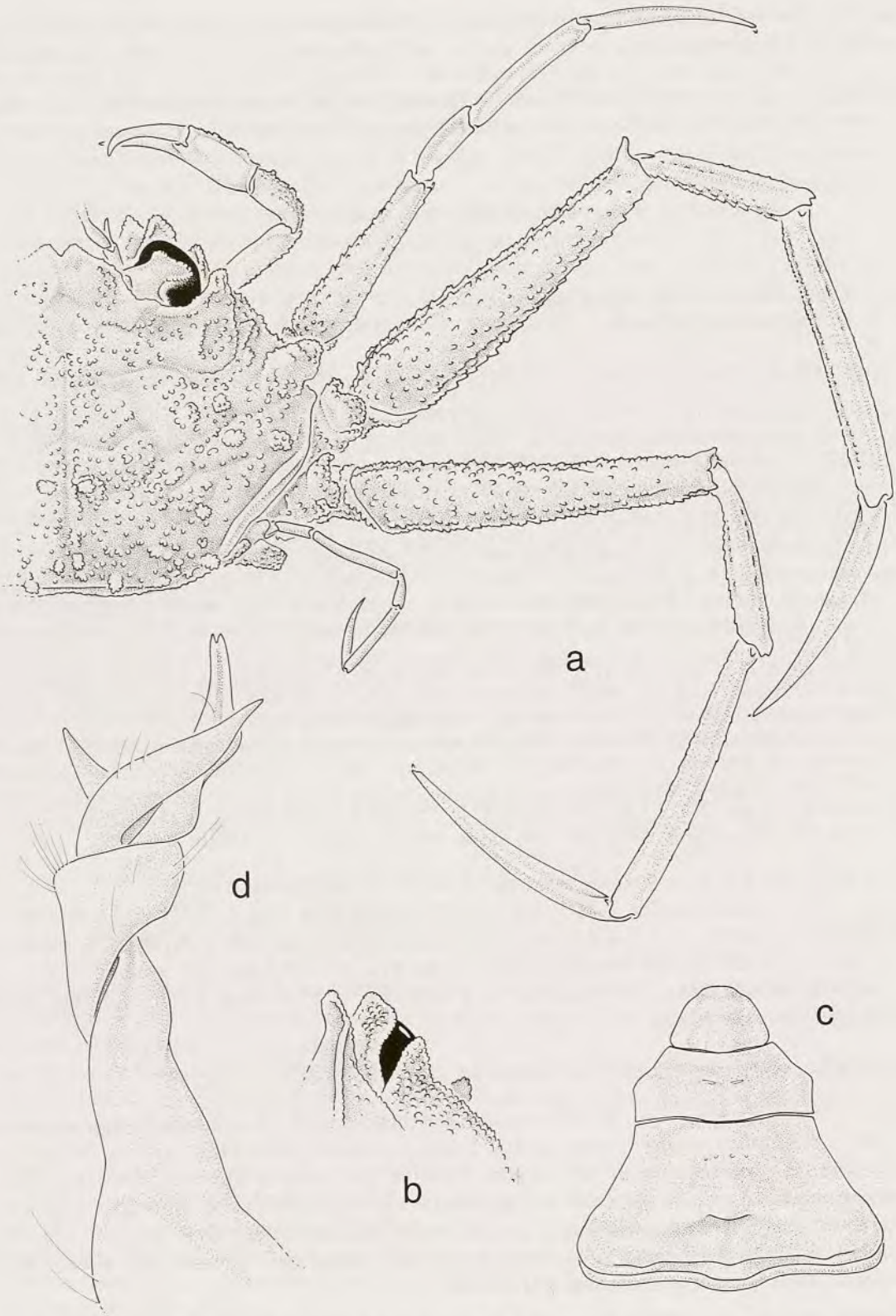


FIG. 18. — *Parapalicus clinodentatus* sp. nov., ♂ holotype 6.2 x 9.0 mm, off east coast of New Caledonia, HALIPRO 1, stn CP 851, 314-364 m (MNHN-B 26701): **a**, carapace and pereopods, dorsal surface; **b**, suborbital border; **c**, abdomen; **d**, left male first pleopod, ventral view.

Source : MNHN, Paris

DESCRIPTION. — Carapace (Figs 18a, 19c) wider than long (CW/CL = 1.4-1.5); dorsal surface covered with coarse granules. Anterolateral borders of carapace each with granular, rounded to triangular tooth bent posteriorly in relation to carapace. Two granular, rounded bosses (one high, close to carapace border plus less conspicuous one), on branchial region posterior to each tooth. Two large but low bosses on metagastric region. Slightly protuberant, granular tubercle at junction of posterolateral and posterior borders. Episternal processes oblong, with rounded tip. Larger specimens with four similar but slightly smaller, granular tubercles that protrude along posterior border. Posterior border with plumose setae.

Frontal border of carapace divided into two small lobes divided by narrow V-shaped notch; slightly rounded tips. Borders between frontal lobes and supraorbital borders slightly pointed medially separates straight anterior half and slightly raised posterior half. Supraorbital borders irregular, undulating, without well-defined notches (slight notch before postorbital angle in some specimens). Postorbital angles short, rounded (slightly pointed in some specimens). Cornea of eyes dorsoventrally flattened, much wider than base of eye peduncle; peduncles without well-defined tubercles.

Suborbital borders (Fig. 18b) each with very narrow, V-shaped gap between inner and outer suborbital lobes. Outer lobe pointed, narrow, slightly shorter than pointed inner lobe. Pterygostomial lobes project slightly ventrally, elongate, pointed, slightly shorter than each inner suborbital lobe.

Each basal antennal segment expanded distally as narrow, pointed process; flagellum long with conspicuous, simple setae. Inner border of ischia of third maxillipeds sinuous to serrate but without defined teeth; surface coarsely granular, upper borders rounded. Meri much narrower than ischia; narrow, pointed (in inner direction) upper borders.

Dorsal borders of cheliped propodi (Fig. 18a) each with carina-like row of irregular tubercles; one additional row of low tubercles along outer surface. Distal half of each finger with 4-5 triangular teeth. Carpi short, outer borders with many pointed tubercles throughout; meri slender, outer border each with 1-2 rows of low tubercles.

First three pairs of walking legs (P2-4; Figs 18a, 19c) very slender, with very elongate meri, filiform propodi and dactyli. Upper and lower borders of meri with small, similarly pointed tubercles (smaller on P2, slightly larger tubercles proximally in P3 of some specimens); distalmost tubercle on each anterior border wider at base, higher, with rounded tip slightly directed distally (particularly in P3). Anterior and posterior borders of carpi, propodi, and dactyli of all walking legs (P2-4) entire, without tubercles (propodi of P3-4 with microscopic tubercles). Each P3 with two dorsal carinae on carpus; one dorsal carina on propodus; one dorsal, one ventral (very slight) carina on dactylus. Each P4 with two dorsal carinae on carpus; one dorsal carina on propodus; one dorsal, one ventral carina each on propodus and dactylus. Meri of all legs with scattered plumose setae; dorsal surfaces of carpi and propodi of P2-4 with rows of plumose setae; dorsal surfaces of dactyli of P2-4 each with one row of conspicuous plumose setae along anterior border.

First pair of walking legs (P2) much shorter and slender than second and third pairs (P3-4); third pair about as long as second pair. Fifth pair of pereopods (P5) short (0.9 CL), very slender; each merus with microscopic tubercles, scattered plumose setae along posterior border; each propodus without setae or with scattered plumose and/or simple setae; each dactylus with 2-3 short spines along posterior border, long simple setae along anterior border, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.6-1.9	2.5-3.1	2.9-3.3	0.9
Merus length/CL	0.5-0.6	0.8-1.1	0.8-1.1	0.3
Dactylus length/Cl	0.5	0.7-0.8	0.8-0.9	0.2

Abdomen of mature males (Fig. 18c) with segments 3-5 fused, two slightly raised tubercles on segment 3 (plus low central prominence), similar one on 4. Male first pleopods (Fig. 18d) with helicoidal basal parts; each distal part with two curved, unequal, pointed tips that cross each other.

Abdomen of mature females with segments 3-5 fused. One transversal ridge along each segment 1-2, two along proximal portion of fused segment 3-5 (very low one may be present on 5).

Source : MNHN, Paris

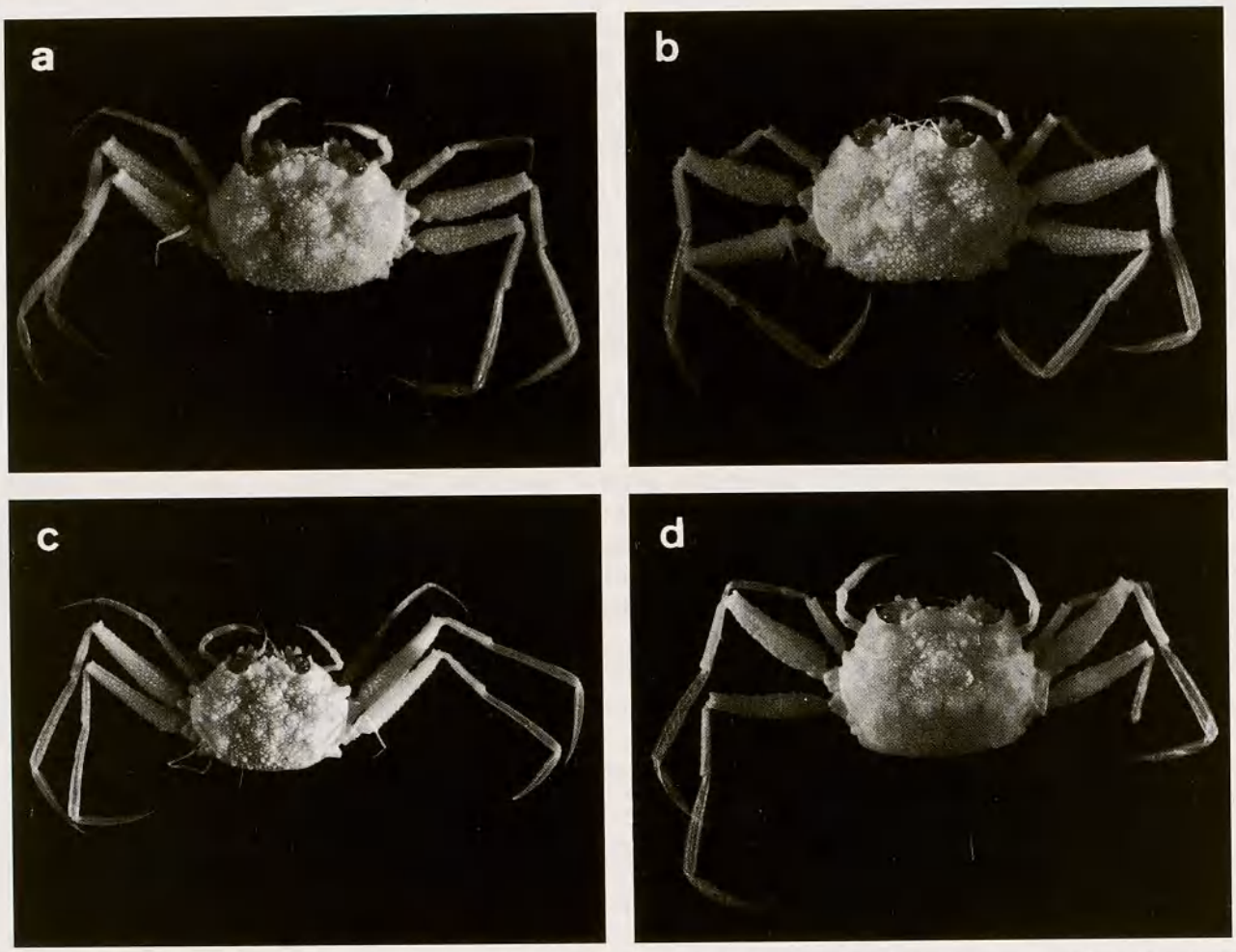


FIG. 19. — **a**, *Parapalicus ambonensis* Moosa & Serène, 1981, ♂ 5.4 x 7.6 mm, Grand Passage, north of New Caledonia, BATHUS 4, stn CP 905, 294-296 m (MNHN-B 26754): dorsal view. — **b**, *Parapalicus armatus* sp. nov.: ♀ paratype 8.1 x 10.6 mm, Loyalty Islands, MUSORSTOM 6, stn DW 481, 300 m (MNHN-B 26700): dorsal view. — **c**, *Parapalicus clinodentatus* sp. nov., ♀ 9.0 x 12.7 mm, off southeast coast of New Caledonia, BATHUS 2, stn CP 742, 340-470 m (MNHN-B 26753): dorsal view. — **d**, *Parapalicus inanis* sp. nov., ♀ paratype 4.9 x 6.2 mm, Chesterfield-Bellona Plateau, MUSORSTOM 10, stn 285, 245-255 m, (MNHN-B 26722): dorsal view.

DISCUSSION. — *P. clinodentatus* is close to *P. unidentatus* (Zarenkov, 1968) since both species share several key characters: a narrow, V-shaped gap between the inner and outer suborbital lobes, a carina-like row of irregular tubercles on the dorsal borders of the chelipeds, two salient teeth on the sides of the carapace, two curved and pointed tips that cross each other on the distal part of the male first pleopods, and relatively low tubercles on the male abdomen. *P. clinodentatus* may be readily differentiated from *P. unidentatus*, however, by having much longer walking legs (total length of P3 varied 2.9-3.3 CL in *P. unidentatus* whereas it is 2.7 CL in *P. clinodentatus*), rounded anterolateral teeth each with its posterior edge bent downward in relation to the rest of the carapace (triangular in shape and a straight continuation of the carapace in *P. unidentatus*), irregular subraorbital borders (two clear notches in *P. unidentatus*), and unequal pointed tips in the male first pleopods (equal in *P. unidentatus*).

SIZE. — Maximum size among specimens examined: 9.0 x 13.1 mm (female, MNHN-B 26752); 7.3 x 10.4 mm (male, MNHN-B 26753).

ETYMOLOGY. — From *clino*, Latin for bend or slant, and *dens*, Latin for tooth, in reference to the diagnostic position of the anterolateral tooth, which is bent in relation to the carapace.

Source : MNHN, Paris

DISTRIBUTION. — Known from the Coral Sea (Vanuatu and New Caledonia) and Fiji (Fig. 57). Depth: known reliably between 320 and 713 m; also collected in trawls between 282-375 and 713-950 m.

Parapalicus denticulatus sp. nov.

Figs 20, 21a, 57

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn CP 1077, 16°04'S, 167°06'E, 180-210 m, 5.10.1994: 2 ♂, 2 ♀ (MNHN-B 26840). — Stn CP 1117, 15°09'S, 166°53'E, 170-220 m, 9.10.1994: 1 ♀ (MNHN-B 26842). — Stn DW 1128, 16°02'S, 166°38'E, 778-811 m, 10.10.1994: 1 ♀ (MNHN-B 26841).

New Caledonia. BATHUS 1: stn 667, 20°57'S, 165°34'E, 205-212 m, 14.03.1993: 7 ♂, 9 ♀ (MNHN-B 26843), 1 ♂ 5.0 x 7.4 mm (MNHN-B 26711), 1 ♂ paratype 5.2 x 7.6 mm (MNHN-B 26712), 1 ♂ holotype 5.2 x 8.0 mm (MNHN-B 26711), 1 ♀ paratype 7.3 x 11.0 mm (MNHN-B 26713). — Stn CP 668, 20°57.21'S, 165°34.57'E, 205-219 m, 14.03.1993: 15 ♂, 9 ♀ (MNHN-B 27002), 1 ♂ (MNHN-B 26839), 1 ♂ paratype 5.0 x 7.6 mm, 1 ♀ paratype 6.8 x 10.2 mm (USNM), 1 ♂ paratype 5.1 x 7.4 mm, 1 ♀ paratype 7.3 x 10.8 mm (ZRC 1999.1433-1434). — Stn CP 669, 20°57'S, 165°35'E, 255-280 m, 14.03.1993: 4 ♂, 4 ♀ (MNHN-B 26756). — Stn DE 700, 20°57'S, 165°34'E, 160-222 m, 18.03.1993: 1 ♀ (MNHN-B 26844). — Stn CP 713, 21°45'S, 166°36'E, 250 m, 19.03.1993: 3 ♂, 7 ♀ (MNHN-B 26755).

HALIPRO 1: stn CP 863, 21°31'S, 166°20'E, 190-227 m, 22.03.1994: 2 ♂, 3 ♀ (MNHN-B 26845).

BATHUS 4: stn CP 953, 21°45'S, 166°36'E, 220-234 m, 11.08.1994: 1 ♀ 7.5 x 10.6 mm (MNHN-B 26715), 1 ♀ (MNHN-B 26846). — Stn 954, 21°44'S, 166°35'E, 255-250 m, 11.08.1994: 1 ♀ parasitized by bopyrid (MNHN-B 96847).

Loyalty Islands. MUSORSTOM 6: stn DW 410, 20°38.05'S, 167°06.65'E, 490 m, 15.02.1989: 1 ♀ (MNHN-B 26848).

TYPES. — *Holotype*: 1 ♂ 5.0 x 7.4 mm, BATHUS 1, stn CP 667 (MNHN-B 26711).

Paratypes: 1 ♂ 5.2 x 7.6 mm, BATHUS 1, stn CP 667 (MNHN-B 26712); 1 ♀ 7.3 x 11.0 mm, BATHUS 1, stn 667 (MNHN-B 26713); 1 ♂ paratype 5.2 x 8.0 mm, BATHUS 1, stn 667 (MNHN-B 26714); 1 ♀ paratype 7.5 x 10.6 mm, BATHUS 4, stn CP 953 (MNHN-B 26715); 1 ♂ 5.0 x 7.6 mm, 1 ♀ 6.8 x 10.2 mm, BATHUS 1, stn CP 668 (USNM); 1 ♂ 5.1 x 7.4 mm, 1 ♀ 7.3 x 10.8 mm, BATHUS 1, stn CP 668 (ZRC 199.1433-1434).

TYPE LOCALITY. — Off east coast of New Caledonia, 20°57.23'S, 165°34.59'E, 205-212 m.

DIAGNOSIS. — Carapace (Figs 20a, 21a) with anterolateral tooth on each side; tooth with truncate outer border and sinuous, nearly straight upper border. Supraorbital borders each with two very slight notches. Suborbital borders (Fig. 20b) each with broad, V-shaped gap between inner and outer suborbital lobes; outer lobe longer than postorbital angle. Dorsal borders of cheliped propodi (Fig. 20c) with rows of microscopic teeth; proximal tubercle on propodus with similar microscopic teeth. Abdomen of mature males (Fig. 20d) with two rounded, elongate tubercles on segment 3; similar but lower one on segment 4. Male first pleopods (Fig. 20e) with helicoidal basal parts; each distal part straight, blade-like, with trigger-like process at base. Abdomen of mature females with one transverse ridge along each segment 1-4 (slightly constricted twice medially in segment 3).

DESCRIPTION. — Carapace (Figs 20a, 21a) wider than long (CW/CL = 1.4-1.5); dorsal surface covered with coarse granules. Smooth sulcus between hepatic and branchial regions connecting with deep fissure between anterolateral tooth and large swelling (with dorsal, rounded boss) along carapace border posterior to postorbital angle. Anterolateral borders of carapace each with tooth covered with fine granules, truncate outer border, tip slightly directed anteriorly, and sinuous, nearly straight upper border. One large, elongate to rounded, granular boss close to carapace border on branchial region posterior to each anterolateral tooth. Two large, low bosses on metagastric region. Episternal processes oblong. Posterior border of carapace with 6-8 slightly protuberant tubercles, plumose setae.

Frontal border of carapace divided into two very broad lobes with straight margins sometimes marked by very slight median notch; lobes divided by narrow V-shaped notch. Borders between frontal lobes and supraorbital borders rounded, slightly raised in posterior portion. Supraorbital borders each with two very slight notches, one before postorbital angle. Postorbital angles very short (shorter than outer lobe of suborbital border), with slightly

Source : MNHN, Paris

pointed tip. Cornea of eyes dorsoventrally flattened, much wider than base of short eye peduncle; peduncles without conspicuous tubercles.

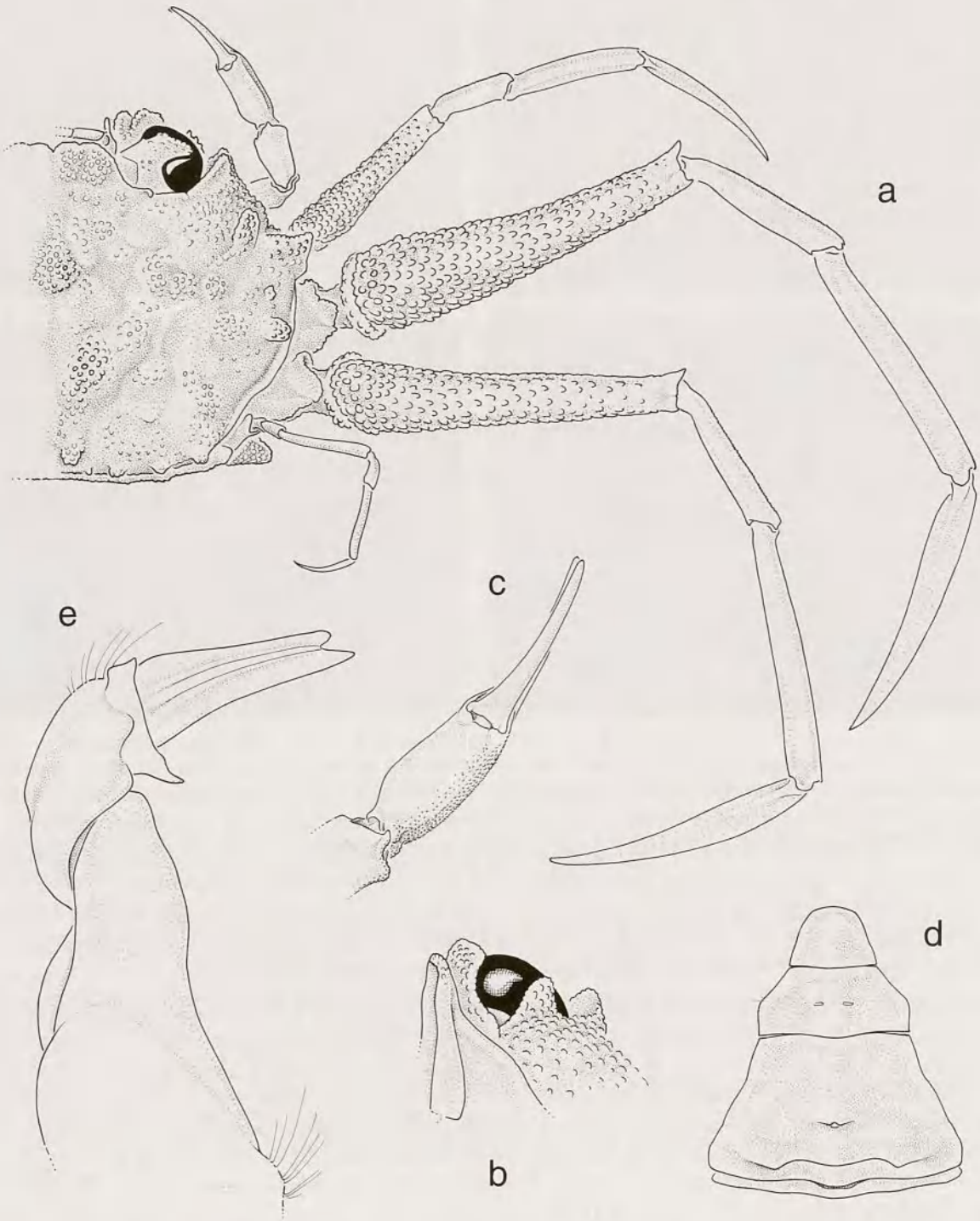


FIG. 20. — *Parapalicus denticulatus* sp. nov.: **a-d**, ♂ holotype 5.0 x 7.4 mm, off south coast of New Caledonia, BATHUS 1, stn CP 667, 205-212 m (MNHN-B 26711): **a**, carapace and pereopods, dorsal surface; **b**, suborbital border; **c**, right cheliped, upper surface; **d**, abdomen. — **e**, ♂ paratype 5.2 x 7.6 mm, off south coast of New Caledonia, BATHUS 1, stn CP 667 (MNHN-B 26712): left male first pleopod, ventral view.

Source : MNHN, Paris

Suborbital borders (Fig. 20b) each with broad, V-shaped gap between inner and outer suborbital lobes. Outer lobe pointed (obliquely directed in some specimens), shorter than pointed inner lobe. Pterygostomial lobes nearly straight, triangular, slightly shorter than each inner suborbital lobe.

Each basal antennal segment expanded distally as slightly pointed process; flagellum long with conspicuous, simple setae. Inner border of ischia of third maxillipeds sinuous to serrate but without defined teeth; surface coarsely granular, upper borders rounded. Meri much narrower than ischia; narrow, pointed (in inner direction) upper borders.

Dorsal borders of cheliped propodi (Fig. 20c) with rows of microscopic teeth; proximal portion of propodi with tubercle with denticulate margin. Distal half of each finger with 4-5 triangular teeth. Carpi short, meri slender, outer borders of both with microscopic teeth throughout.

First three pairs of walking legs (P2-4; Figs 20a, 21a) very slender, with very elongate meri, filiform propodi and dactyli. Upper and lower borders of meri with small, similarly pointed tubercles (slightly larger tubercles proximally in some specimens); distalmost tubercle on each anterior border wider at base, higher, with conspicuously pointed tip directed distally in P3-4 (similar tubercle but not conspicuously pointed in P2). Anterior and posterior borders of carpi, propodi, and dactyli of all walking legs (P2-4) entire. Each P2 with one dorsal (very slight) carina on dactylus. P3-4 each with one dorsal carina on carpus, propodus (very slight), and dactylus. Meri of all legs with scattered plumose setae; dorsal surfaces of propodi of P3-4 with rows of plumose setae; dorsal surfaces of dactyli of P2-4 each with one row of conspicuous plumose setae along anterior border.

First pair of walking legs (P2) much shorter and slender than second and third pairs (P3-4); third pair about as long as second pair. Fifth pair of pereopods (P5) short (0.8-0.9 CL), very slender; each merus with scattered plumose setae along posterior border; each propodus with smooth borders, scattered plumose setae along anterior and posterior borders; each dactylus with 1-4 short spines increasing in length distally along posterior border, long simple setae along anterior and posterior borders, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.5-1.7	2.8-2.9	2.6-2.8	0.8-0.9
Merus length/CL	0.5	0.9	0.9	0.2-0.3
Dactylus length/Cl	0.5	0.7-0.8	0.7	0.2

Abdomen of mature males (Fig. 20d) with segments 3-5 fused, two rounded, elongate tubercles on segment 3, similar but slightly lower tubercle on segment 4. Male first pleopods (Fig. 20e) with helicoidal basal parts; each distal part straight, blade-like, corneus distal part; proximal, ventrally pointed, trigger-like process.

Abdomen of mature females with segments 3-5 fused. One ridge along each segment 1-2, two along proximal portion of fused segment 3-5 (slightly constricted twice medially in segment 3).

DISCUSSION. — *P. denticulatus* is very close to *P. inermis* sp. nov. It differs from the later by the presence of numerous, very small teeth on the dorsal surface of the propodi of the chelipeds (nearly smooth in *P. inermis*), a trigger-like process at the base of a shorter and straight distal part in each male first pleopod, much lower tubercles on the male abdomen, and slightly longer second walking legs in relation to carapace length (2.8-2.9 CL against 3.0-3.5 CL in *P. inermis*). There is also a difference in size, adult *P. denticulatus* being larger than adult *P. inermis*. In *P. inermis* the average carapace length of all specimens available for measurement was 5.1 mm in males (4.1-5.3 mm, N = 22) and 6.6 mm in females (5.1-7.5 mm, N = 33) in contrast to 4.1 mm in males (3.7-4.4 mm, N = 11) and 5.7 mm in females (4.1-6.3 mm; N = 112) in *P. inermis*. Morphological differences (most significantly between the male first pleopods) and the large number of morphologically similar specimens collected in separate geographical locations indicate that *P. denticulatus* and *P. inermis* are different species and not merely populations of different age groups that belong to only one species.

There are also some similarities with *P. ambonensis*. As in *P. denticulatus*, the anterolateral teeth of *P. ambonensis* have truncate outer borders. The upper borders, however, are short and rounded (which makes the teeth look conspicuously narrow), not long and nearly straight as in *P. denticulatus*. *P. ambonensis* can be easily

Source : MNHN, Paris

identified by a very short second suborbital tooth, the presence of two tubercles along the dorsal border of each cheliped propodus, and male first pleopods with a beak-like distal part (Fig. 16c).

P. denticulatus also shares with *P. unidentatus* (Zarenkov, 1968) the morphology of the dorsal surface of its carapace, which is covered (except the cervical groove and areas around the gastric portion) by granular bosses and anterolateral borders that are each armed with a triangular tooth and a conspicuous blunt boss at the branchial region posterior to the anterolateral tooth. The two species can be distinguished by the morphology of their male first pleopods (much more complex in *P. unidentatus*, with each distal part consisting of two pointed tips that cross each other; MOOSA & SERÈNE, 1981, fig. 4), the ornamentation of the cheliped propodi (carina-like row of irregular tubercles in *P. unidentatus*), and the gap between the inner and outer suborbital lobes (U-shaped in *P. denticulatus*, narrow and V-shaped in *P. unidentatus*; ZARENKOV, 1968, fig. 3B).

P. denticulatus also shares with *P. trituberculatus* (Chen, 1981) similarities in carapace shape and in the presence of microscopic teeth on the dorsal borders of the cheliped propodi. They differ from each other by the morphology of their male first pleopods (pointed distal parts that are bordered with spinules along the ventral borders in *P. trituberculatus*; Figs 28a-b), the gap between the inner and outer suborbital lobes (much broader, almost circular in *P. trituberculatus*; CHEN, 1981, pl. 2, fig. 1), and the relative length of the walking legs (shorter in *P. trituberculatus*, P3 only 2.1-2.4 CL and P4 2.3 CL).

SIZE. — Maximum size among specimens examined: 7.5 x 11.2 mm (female, MNHN-B 26755); 5.3 x 7.9 mm (male, MNHN-B 26756).

ETYMOLOGY. — From *denticulus*, the Latin diminutive of *dens*, or tooth, in reference to the diagnostic rows of microscopic teeth along the dorsal surface and anterior border of the cheliped propodi.

DISTRIBUTION. — Known only from the Coral Sea (Vanuatu, New Caledonia, and Loyalty Islands) (Fig. 57). Depth: known reliably between 210 and 778 m; also collected in trawls between 160-222 and 778-811 m.

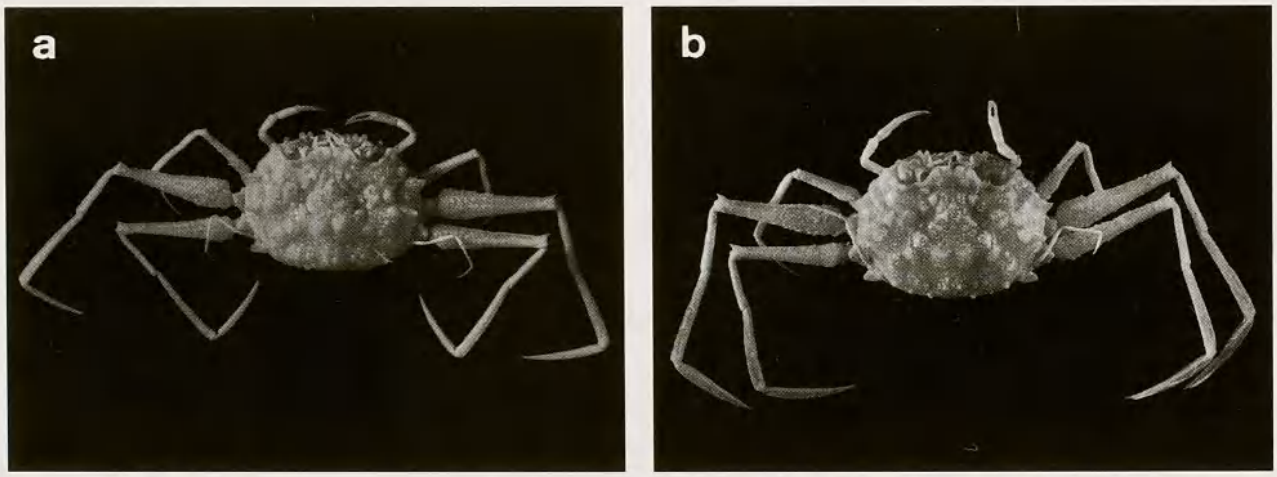


FIG. 21. — **a**, *Parapalicus denticulatus* sp. nov.: ♀ paratype 7.5 x 10.6 mm, off west coast of New Caledonia, BATHUS 4, stn CP 953, 220-234 m (MNHN-B 26715): dorsal view. — **b**, *Parapalicus inermis* sp. nov., ♀ paratype 5.3 x 7.9 mm, Fiji, MUSORSTOM 10, stn CP 1351, 292-311 m (MNHN-B 26720): dorsal view.

Parapalicus inermis sp. nov.

Figs 21b, 22, 57

MATERIAL EXAMINED. — **Fiji**. MUSORSTOM 10: stn CP 1322, 17°17.10'S, 177°47.92'E, 225-285 m, 7.08.1998: 1 ♀ (MNHN-B 26856). — Stn CP 1323, 17°16.10'S, 177°45.75'E, 143-173 m, 7.08.1998: 1 ♂ paratype 4.4 x 6.8 mm (MNHN-B 26717), 1 ♂, 31 ♀ (MNHN-B 26757), 1 ♂ paratype 3.9 x 6.6 mm, 1 ♀ paratype 5.7 x 8.3 mm (USNM). —

Source : MNHN, Paris

Stn CP 1324, 17°17.37'S, 177°47.05'E, 102-104 m, 7.08.1998: 1 ♂, 1 ♀ (MNHN-B 26858). — Stn CP 1325, 17°16.39'S, 177°49.80'E, 282-322 m, 7.08.1998: 1 ♀ (MNHN-B 26859). — Stn CP 1349, 17°31.07'S, 178°38'79'E, 244-252 m, 11.08.1998: 2 ♂, 15 ♀ (MNHN-B 26850). — Stn CP 1351, 17°31.14'S, 178°39.96'E, 292-311 m, 11.08.1998: 1 ♀ paratype 5.4 x 8.0 mm (MNHN-B 26719), 1 ♀ paratype 5.3 x 7.9 mm (MNHN-B 26720), 7 ♀ (MNHN-B 26851). — Stn CP 1355, 17°49.54'S, 178°49.39'E, 302-310 m, 12.08.1998: 1 ♂ holotype 4.2 x 6.4 mm (MNHN-B 26716), 1 ♀ paratype 5.7 x 8.4 mm (MNHN-B 26718), 4 ♀ (MNHN-B 26852). — Stn CP 1358, 17°48.49'S, 178°46.70'E, 80-120 m, 13.08.1998: 1 ♀ (MNHN-B 26857). — Stn CP 1363, 18°12.39'S, 178°33.01'E, 144-150 m, 15.08.1998: 2 ♂, 19 ♀ (MNHN-B 26849). — Stn DW 1365, 18°12.73'S, 178°32.38'E, 295-302 m, 15.08.1998: 1 ♀ (MNHN-B 26860). — Stn DW CP 1366, 18°12.36'S, 178°33.06'E, 149-168 m, 15.08.1998: 1 ♂, 6 ♀ (MNHN-B 26853). — Stn CP 1370, 18°12.32'S, 178°33.10'E, 113-123 m, 16.08.1998: 1 ♂, 12 ♀ (MNHN-B 26854). — Stn CP 1371, 18°12.36'S, 178°32.85'E, 135-151 m, 16.08.1998: 12 ♀ (MNHN-B 26855).

BORDAU 1: stn CP 1403, 16°40'S, 179°36'E, 220-224 m, 25.02.1999: 1 ♂, 4 ♀ (MNHN-B 27136). — Stn CP 1405, 16°39'S, 179°36'E, 180 m, 25.02.1999: 2 ♀ (MNHN-B 27137).

TYPES. — *Holotype*: 1 ♂ 4.2 x 6.4 mm, MUSORSTOM 10, stn CP 1355 (MNHN-B 26716).

Paratypes: 1 ♂ 4.4 x 6.8 mm, MUSORSTOM 10, stn CP 1323 (MNHN-B 26717); 1 ♀ 5.7 x 8.4 mm, MUSORSTOM 10, stn CP 1355 (MNHN-B 26718); 1 ♀ 5.4 x 8.0 mm, MUSORSTOM 10, stn CP 1351 (MNHN-B 26719); 1 ♀ 5.3 x 7.9 mm, MUSORSTOM 10, stn CP 1351 (MNHN-B 26720); 1 ♂ 3.9 x 6.6 mm, 1 ♀ 5.7 x 8.3 mm, MUSORSTOM 10, stn CP 1323 (USNM).

TYPE LOCALITY. — Off east coast of Viti Levu, Fiji, 17°49.54'S, 178°49.39'E, 302-310 m.

DIAGNOSIS. — Carapace (Figs 21b, 22a) with one anterolateral tooth on each side; tooth with truncate outer border, sinuous, nearly straight upper border. Supraorbital borders each with two very slight notches. Suborbital borders (Fig. 22b) each with broad, V- or L-shaped gap between inner and outer suborbital lobes; outer lobe longer than postorbital angle. Dorsal borders of cheliped propodi (Fig. 22c) nearly smooth, only with barely visible microscopic teeth; proximal tubercle smooth. Abdomen of mature males (Fig. 22d) with two low, elongate tubercles on segment 3; similar but slightly lower one on segment 4. Male first pleopods (Fig. 22e) with helicoidal basal parts; each distal part blade-like, corneous, proximally curved but distally widened. Abdomen of mature females with segments 3-5 fused; one transverse ridge along each segment 1-4 (slightly constricted twice medially in segment 3).

Color: A color photograph of a live specimen showed a red-brown carapace, light red-brown tubercles on the meri of the walking legs, and narrow, red-brown bands across the walking legs. Some of the color shown in the photographs remained in specimens that had been preserved in alcohol for nine months.

DESCRIPTION. — Carapace (Figs 21b, 22a) wider than long (CW/CL = 1.4-1.5); dorsal surface covered with coarse granules. Smooth sulcus between hepatic and branchial regions connecting with deep fissure between anterolateral tooth and large swelling (with dorsal, rounded boss) along carapace border posterior to postorbital angle. Anterolateral borders of carapace each with tooth covered with fine granules, truncate outer border, tip slightly directed anteriorly, and sinuous, nearly straight upper border. One large, elongate to rounded, granular boss close to carapace border on branchial region posterior to each anterolateral tooth. Two large, low bosses on metagastric region. Episternal processes oblong. Posterior border of carapace with 6-8 slightly protuberant tubercles, plumose setae.

Frontal border of carapace divided into two very broad lobes with straight margins sometimes marked by very slight median notch; lobes divided by narrow V-shaped notch. Borders between frontal lobes and supraorbital borders rounded, slightly raised in posterior portion. Supraorbital borders each with two very slight notches, one before postorbital angle. Postorbital angles very short (shorter than outer lobe of suborbital border), with slightly pointed tip. Cornea of eyes dorsoventrally flattened, much wider than base of short eye peduncle; peduncles without conspicuous tubercles.

Suborbital borders (Fig. 22b) each with broad, V-shaped gap between inner and outer suborbital lobes. Outer lobe pointed (obliquely directed in some specimens), shorter than pointed inner lobe. Pterygostomial lobes nearly straight, triangular, slightly shorter than each inner suborbital lobe.

Each basal antennal segment expanded distally as slightly pointed process; flagellum long with conspicuous, simple setae. Inner border of ischia of third maxillipeds sinuous to serrate but without defined teeth;

Source : MNHN, Paris

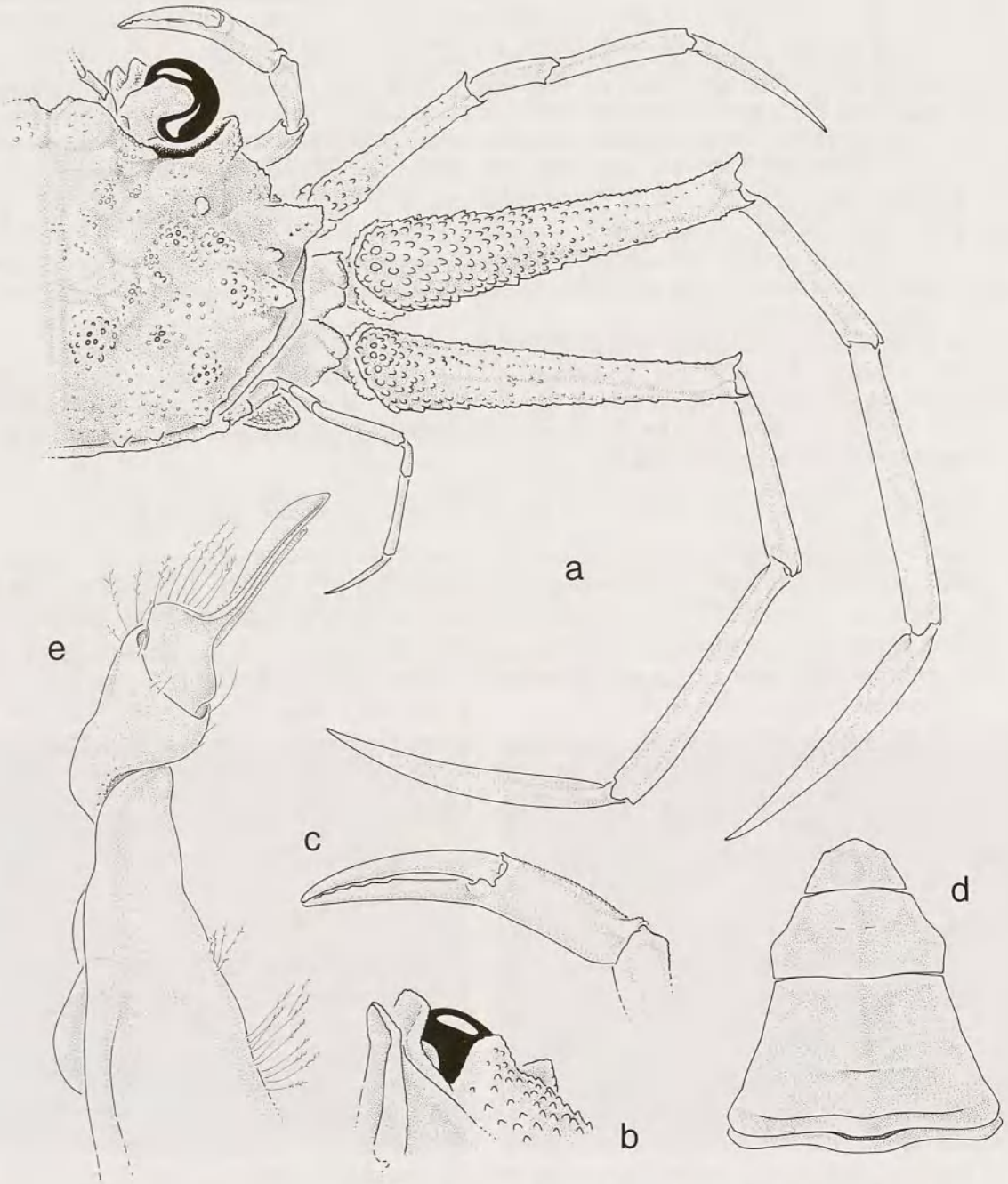


FIG. 22. — *Parapalicus inermis* sp. nov., ♂ holotype 4.2 x 6.4 mm, east of Viti Levu, Fiji, MUSORSTOM 10, stn CP 1355, 302-310 m (MNHN-B 26716): **a**, carapace and pereopods, dorsal surface; **b**, suborbital border; **c**, right cheliped, upper surface; **d**, abdomen; **e**, left male first pleopod, ventral view.

surface coarsely granular, upper borders rounded. Meri much narrower than ischia; narrow, pointed (in inner direction) upper borders.

Dorsal and outer borders of cheliped propodi (Fig. 22c) nearly smooth, only with barely visible microscopic teeth; low, rounded tubercle at proximal to each propodal-carpal joint. Distal half of each finger with 4-5 teeth (triangular in smaller females, low and rounded in larger females). Carpi short, outer borders smooth; meri slender, outer borders smooth.

Source : MNHN, Paris

First three pairs of walking legs (P2-4; Figs 21b, 22a) very slender, with elongate meri, filiform propodi and dactyli. Upper and lower borders of meri with small, similarly pointed tubercles (smaller on P2); distalmost tubercle on each anterior border much wider at base, higher, with pointed tip directed distally in P3-4 (similar tubercle but not conspicuously pointed in P2). Anterior and posterior borders of carpi, propodi, and dactyli of all walking legs (P2-4) entire. Each P2 with one dorsal (very slight) carina on dactylus. Each P3 with one dorsal carina on carpus; one dorsal (very slight) carina on propodus; one dorsal carina on dactylus. Each P4 with one dorsal carina each on carpus, propodus, and dactylus. Meri of all legs with scattered plumose setae; dorsal surfaces of propodi of P3-4 with rows of plumose setae; dorsal surfaces of dactyli of P2-4 each with one row of conspicuous plumose setae along anterior border.

First pair of walking legs (P2) much shorter and slender than second and third pairs (P3-4); third pair about as long as second pair. Fifth pair of pereopods (P5) short (0.8-0.9 CL), very slender; each merus with scattered plumose setae along posterior border; each propodus with smooth borders, long plumose setae along anterior and posterior borders; each dactylus with 1-4 spines increasing in length distally along posterior border, long, simple setae along anterior and posterior borders, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.5-1.8	3.0-3.5	2.8-3.3	0.8-0.9
Merus length/CL	0.5-0.6	0.9-1.1	0.9-1.1	0.2-0.3
Dactylus length/Cl	0.4-0.5	0.8-0.9	0.7-0.8	0.2

Abdomen of mature males (Fig. 22d) with segments 3-5 fused, two low, elongate tubercles on segment 3, similar but lower on segment 4. Male first pleopods (Fig. 22e) with helicoidal basal parts; each distal part long, blade-like, proximally curved, distally widened.

Abdomen of mature females with segments 3-5 fused. One transversal ridge along each segment 1-2, one along proximal portion of fused segment 3-5 (slightly constricted twice medially in segment 3).

DISCUSSION. — *P. inermis* is very close to *P. denticulatus* sp. nov., which is known only from the Coral Sea region (Vanuatu to Loyalty Islands), while *P. inermis* is only known from Fiji (see discussion for *P. denticulatus*). There are also some similarities with *P. ambonensis* on account of the presence of anterolateral teeth that have obtuse outer borders.

P. inermis has legs that are unusually long in relation to carapace length. The total length of the second pair of walking legs (P3) varied between 3.0-3.5 CL, the longest in any known species of *Parapalicus*.

SIZE. — Maximum size among the females examined: 6.3 x 9.4 mm (MNHN-B 26757); the largest of the males examined: 4.4 x 6.8 mm (MNHN-B 26717).

ETYMOLOGY. — From *inermis*, Latin for unarmed, in reference to the smooth appearance of the outer border of the cheliped propodi.

DISTRIBUTION. — Known only from Fiji (Fig. 57). Depth: known reliably between 104 and 302 m; also collected in trawls between 80-120 and 282-322 m.

Parapalicus elaniticus (Holthuis, 1977)

Fig. 57

Palicus elaniticus Holthuis, 1977: 185, figs 3a-f.

MATERIAL EXAMINED. — **Red Sea**. Gulf of Aqaba, off Elat, *"La-Merkhav"*, stn 8, 60-80 m, C. LEWINSOHN coll., 7.09.1966: 1 ♂ holotype of *Palicus elaniticus* Holthuis 3.5 x 4.5 mm (RMNH 30334).

Madagascar. *"Vauban"*: stn CH 52, off Majunga (northwest coast), 15°21.0'S, 46°12.5'E, 150 m, mud, A. CROSNIER coll., 8.11.1972: 1 ♀ (MNHN-B 26758).

Source : MNHN, Paris

TYPES. — *Holotype* of *Palicus elaniticus* Holthuis, 1977: 1 ♂ 3.5 x 4.5 mm, *"La-Merkhav"*, stn 8 (RMNH 30334).

TYPE LOCALITY. — Off Elat, Gulf of Aqaba, Red Sea, 60-80 m.

DIAGNOSIS. — Carapace (HOLTHUIS, 1977, fig. 3a) with triangular, anteriorly-pointed anterolateral tooth on each side. Supraorbital borders each with two slight notches, distalmost one followed by rounded, lobe-like tubercle located on proximal border of postorbital angle. Suborbital borders (HOLTHUIS, 1977, fig. 3b) each with U-shaped gap between inner and outer suborbital lobes; outer lobe much smaller than inner lobe. Dorsal border of cheliped propodi (HOLTHUIS, 1977, fig. 3d) each with two proximal tubercles. Abdomen of male holotype (HOLTHUIS, 1977, fig. 3f) with two low tubercles on segment 3, lower one on segment 4. Male first pleopods (HOLTHUIS, 1977, fig. 3g) with helicoidal basal parts; each distal part blade-like, bordered with small teeth and two wing-like proximal processes. Abdomen of only mature female examined with one transverse ridge along each segment 1-4.

DISCUSSION. — A character diagnostic of *P. elaniticus* is the rounded tubercle on the supraorbital border proximal to each postorbital angle, which gives the angle a bilobed appearance (HOLTHUIS, 1977, fig. 3a). The two specimens that were examined in this study had a notch on the middle portion of each of the supraorbital borders. The description of the species, however, mentions that the borders lack any "distinct incisions" other than the notch before the tubercle proximal to the postorbital angles (HOLTHUIS, 1977: 185). The distal half of the cheliped fingers of the female examined was armed with 3 triangular teeth, the pollex with 5. They were absent, however, in the male holotype (HOLTHUIS, 1977, fig. 3d).

The length of the walking legs was measured only in the Madagascar specimen (MNHN-B 26758): total length of second and third pair of walking legs (P3-4) was 2.1 CL (P3 merus 0.6 CL, dactylus 0.5 CL; P4 merus 0.5 CL, dactylus 0.5 CL).

SIZE. — Size of the only two specimens known to exist: 6.5 x 8.9 mm (female, MNHN-B 26758), 3.5 x 4.5 mm (male holotype, RMNH 30334).

DISTRIBUTION. — Previously known only from the Gulf of Aqaba, Red Sea (HOLTHUIS, 1977). Its distribution is now extended to the northwest coast of Madagascar (Fig. 57). Depth: known reliably between 80 and 150 m; also collected in a trawl between 60 and 80 m.

Parapalicus inanis sp. nov.

Figs 19d, 23, 57

MATERIAL EXAMINED. — **Chesterfield-Bellona Plateau**. MUSORSTOM 5: stn 280, 24°09.99'S, 159°35.75'E, 270 m, 10.10.1986: 1 ♂ holotype 3.9 x 4.7 mm (MNHN-B 6721), 1 ♀ (MNHN-B 26824). — Stn 282, 24°11.55'S, 159°32.22'E, 226-230 m, 10.10.1986: 2 ♀ (MNHN-B 26825), 1 ♀ paratype 4.7 x 6.0 mm (USNM). — Stn 285, 24°09.35'S, 159°34.04'E, 245-255 m, 10.10.1986: 1 ♀ paratype 4.9 x 6.2 mm (MNHN-B 26722).

BATHUS 2: stn DW 752, 22°22.32'S, 166°14.9'E, 330 m, 15.05.1993: 1 ♀ (MNHN-B 26826).

Loyalty Islands. MUSORSTOM 6: stn DW 462, 21°05.10'S, 167°26.85'E, 200 m, 21.02.1989: 1 ♀ paratype 4.4 x 5.8 mm (MNHN-B 26723).

TYPES. — *Holotype*: 1 ♂ 3.9 x 4.7 mm, MUSORSTOM 5, stn 280 (MNHN-B 26721).

Paratypes: 1 ♀ 4.9 x 6.2 mm, MUSORSTOM 5, stn 285 (MNHN-B 26722); 1 ♀ 4.4 x 5.8 mm, MUSORSTOM 6, stn DW 462 (MNHN-B 26723); 1 ♀ 4.7 x 6.0 mm, MUSORSTOM 5, stn 282 (USNM).

TYPE LOCALITY. — Kelso Bank, Chesterfield-Bellona Plateau, Coral Sea, 24°09.99'S, 159°35.75'E, 270 m.

DIAGNOSIS. — Carapace (Figs 19d, 23a) with small anterolateral tooth on each side; dorsal surface covered with many small granules. Frontal lobes each with slight notch. Supraorbital borders each with two slight notches. Suborbital borders (Fig. 23b) each without outer suborbital lobe, leaving very wide gap between inner

Source : MNHN, Paris

suborbital lobe and postorbital angle. Dorsal borders of cheliped propodi (Fig. 23c) each with two proximal tubercles, microscopic teeth. Abdomen of mature males with two rounded tubercles on segment 3, very low one on segment 4. Male first pleopods (Figs 23d-e) with sinuous basal parts; each distal part curved, corneous apex with spinules. Abdomen of mature females (Fig. 23f) with segments 3-5 fused; straight or twice-constricted transverse ridge on segment 3, segment 4 smooth or with short ridge at each outer edge.

DESCRIPTION. — Carapace (Figs 19d, 23a) wider than long (CW/CL = 1.2-1.3); dorsal surface covered with small granules. Anterolateral borders of carapace each with very small triangular tooth covered with fine granules. Two bosses (more conspicuous in larger specimens) on metagastric region. Large granules on branchial region and along posterior border (number and distribution varies among specimens). Episternal processes small, rounded (more protuberant in larger specimens). Posterior border of carapace with very few plumose setae in some specimens.

Frontal border of carapace divided into two small lobes divided by narrow V-shaped notch; each rounded lobe divided into two very low lobes by slight notch. Borders between frontal lobes and supraorbital borders rounded. Supraorbital borders each with two very slight notches (larger specimens with irregular borders without clear notches). Postorbital angles short, slightly pointed. Cornea of eyes dorsoventrally flattened, slightly wider than base of eye peduncle; each peduncle with two slightly granular, distal tubercles (ventral the largest).

Suborbital borders (Fig. 23b) each without outer suborbital lobe, leaving very wide gap between inner suborbital lobe and postorbital angle. Pterygostomial lobes straight, broad, rounded, only slightly shorter than each inner suborbital lobe.

Each basal antennal segment expanded distally as rounded process; flagellum long with conspicuous, simple setae. Inner border of ischia of third maxillipeds sinuous to serrate but without defined teeth; surface finely granular, upper borders rounded. Meri much narrower than ischium; rounded, broad upper borders.

Dorsal borders of cheliped propodi (Fig. 23c) each with two proximal tubercles and microscopic teeth. Distal two-thirds of each finger with 3-4 short teeth. Carpi short, outer borders with few, mostly microscopic tubercles; meri slender, outer borders with scattered, low tubercles.

First three pairs of walking legs (P2-4; Figs 19d, 23a) very slender, with elongate meri, filiform propodi and dactyli. Upper and lower borders of meri with similar, slightly pointed tubercles (smaller along anterior border of P2); distalmost tubercle on each anterior border much wider at base, higher, rounded tip directed distally. Anterior and posterior borders of carpi, propodi, and dactyli of all walking legs (P2-4) entire, without tubercles. Each P2 with one dorsal carina on carpus. P3-4 each with one dorsal carina on carpus, propodus (very slight), and dactylus. Dorsal surfaces of meri of all legs and carpi and propodi of P3-4 with scattered plumose setae; dorsal surfaces of dactyli of P3-4 each with one row of conspicuous plumose setae along anterior border.

First pair of walking legs (P2) much shorter and slender than second and third pairs (P3-4); third pair about as long as second pair. Fifth pair of pereopods (P5) short (0.9 CL), very slender; each merus with 3 spines; each propodus with 2-4 spines along posterior border, scattered plumose setae along anterior border; each dactylus smooth, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.3-1.4	2.4-2.5	2.1-2.3	0.9
Merus length/CL	0.4	0.7-0.8	0.6-0.7	0.2-0.3
Dactylus length/Cl	0.4	0.6	0.5-0.6	0.2

Abdomen of only mature male examined (holotype) with segments 3-5 fused, two conspicuous, rounded to elongate tubercles on segment 3, one very low tubercle on segment 4. Male first pleopods (Figs 23d-e) with sinuous basal parts; each distal part with corneous apex, tip with spinules.

Abdomen of mature females (Fig. 23f) with segments 3-5 fused. One ridge along each segment 1-2; segment 3 of fused segment 3-5 with ridge straight or slightly constricted twice medially; segment 4 smooth or with very low, short ridge at each outer edge.

Source : MNHN, Paris

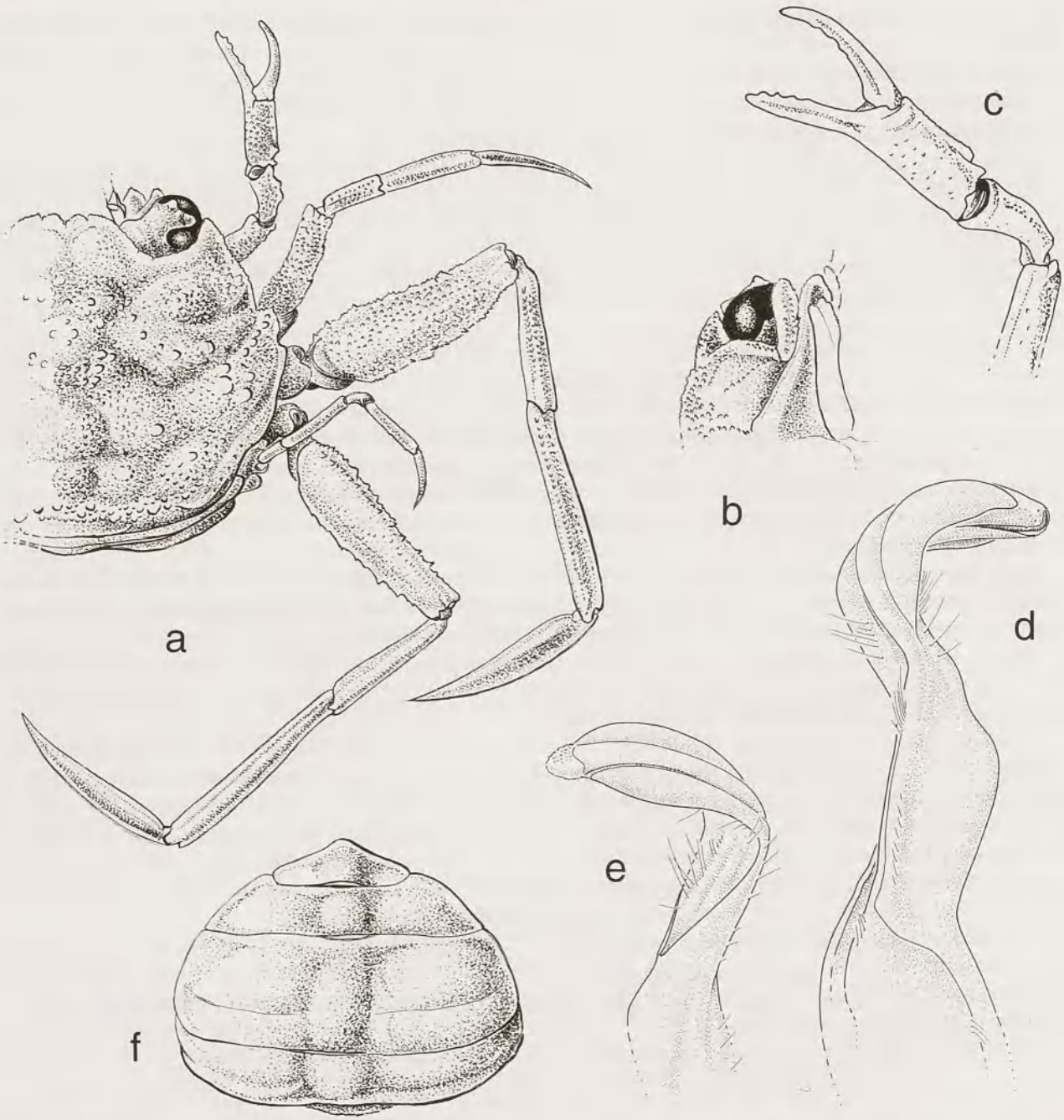


FIG. 23. — *Parapalicus inanis* sp. nov.: **a-c, f**, ♀ paratype 4.4 x 5.8 mm, Loyalty Islands, MUSORSTOM 6, stn DW 462, 200 m (MNHN-B 26723): **a**, carapace and pereopods, dorsal surface; **b**, suborbital border; **c**, left cheliped, outer surface; **f**, abdomen. — **d-e**, ♂ holotype 3.9 x 4.7 mm, Kelso Bank, Chesterfield-Bellona Plateau, Coral Sea, MUSORSTOM 5, stn 280, 270 m (MNHN-B 26721): **d**, left male first pleopod, ventral view; **e**, left male first pleopod, distal part, dorsal view;

DISCUSSION. — *P. inanis* is unique among the known species of the genus in the absence of an outer suborbital lobe. Like in *P. armatus* sp. nov., the anterolateral teeth are unusually small. It shares with *P. nanshaensis* Chen, 1981 a cheliped merus that is armed with two basal tubercles.

All of the seven specimens that were examined in this study were unusually small for *Parapalicus*, the largest specimen being only 4.9 x 6.2 mm (MNHN-B 26722).

Source : MNHN, Paris

SIZE. — Maximum size among the six females examined: 4.9 x 6.2 mm (MNHN-B 26722); the only male examined (MNHN-B 26721): 3.9 x 4.7 mm.

ETYMOLOGY. — From *inanis*, Latin for empty, in reference to the empty appearance of the suborbital region due to the absence of the outer suborbital lobe.

DISTRIBUTION. — Known only from the Coral Sea (New Caledonia and the Loyalty Islands) (Fig. 57). Depth: 200-330 m.

Parapalicus microphthalmus sp. nov.

Figs 24, 26a, 57

MATERIAL EXAMINED. — **Madagascar**. *"Vauban"*: stn CH 52, off Majunga (northwest coast), 15°21.0'S, 46°12.5'E, 150 m, A. CROSNIER coll., 8.11.1972: 1 ♂ paratype 7.3 x 11.4 mm (MNHN-B 26725), 1 ♂ paratype 5.9 x 9.6 mm (MNHN-B 26726), 1 ♀ holotype 7.8 x 11.2 mm (MNHN-B 26724), 2 ♀ (MNHN-B 26827).

TYPES. — *Holotype*: 1 ♀ 7.8 x 11.2 mm (MNHN-B 26724).
Paratypes: 1 ♂ 7.3 x 11.4 mm (MNHN-B 26725); 1 ♂ 5.9 x 9.6 mm (MNHN-B 26726).
TYPE LOCALITY. — Off northwest coast of Madagascar, 15°21.0'S, 46°12.5'E, 150 m.

DIAGNOSIS. — Carapace (Figs 24a, 26a) with conspicuous, triangular anterolateral tooth on each side. Supraorbital borders sinuous, each with two notches. Cornea and eye peduncle small; peduncles with many pointed granules. Suborbital borders (Fig. 24b) each with wide, U-shaped gap between inner and outer, dentiform, suborbital lobes. Dorsal border of cheliped propodi each with very low carina bordered with microscopic teeth. Abdomen of mature males (Fig. 24c) with two low, elongate tubercles on segment 3, triangular one on segment 4. Male first pleopods (Figs 24d-e) with helicoidal basal parts; each distal part with helicoidal, keel-like process, curved, corneous apex. Abdomen of mature females with one transverse ridge along each segment 1-4.

DESCRIPTION. — Carapace (Figs 24a, 26a) wider than long (CW/CL = 1.4-1.6); dorsal surface covered with very coarse granules. Anterolateral borders of carapace each with conspicuous triangular tooth covered with granules. Two bosses, also covered with granules, on branchial region posterior to each tooth; larger, more pointed of the two bosses closer to border of carapace, giving carapace appearance of having two anterolateral teeth. Four conspicuous bosses (two large median bosses flanked by smaller one on each side) on metagastric region. Episternal processes triangular, with conspicuous granules. Posterior border of carapace with several rounded tubercles (6 protuberant tubercles in males), scattered plumose setae.

Frontal border of carapace divided into two small lobes divided by wide U-shaped notch; triangular tips. Borders between frontal lobes and supraorbital borders rounded. Supraorbital borders sinuous, each with two notches. Postorbital angles short, slightly pointed. Cornea of eyes small, dorsoventrally flattened, wider than base of eye peduncle; peduncles with many small, pointed granules.

Suborbital borders (Fig. 24b) each with wide, U-shaped gap between inner and outer suborbital lobes. Outer lobe narrow, pointed, shorter than similarly pointed (projected outwards when seen dorsally) inner lobe. Pterygostomial lobes projecting slightly ventrally, pointed, equal in length to each inner suborbital lobe.

Each basal antennal segment expanded distally as elongate, granular process; flagellum long with conspicuous, simple setae. Inner border of ischia of third maxillipeds slightly sinuous; surface coarsely granular, upper borders slightly pointed. Meri much narrower than ischium; pointed, granular upper borders.

Dorsal and outer borders of cheliped propodi (Fig. 24a) each with very low, unarmed (only barely visible microscopic teeth) carina, low proximal tubercle. Distal half to two-thirds of each finger with 3-7 short teeth. Carpi short, outer borders with broad tubercle across distal portion, pointed tubercles throughout; meri slender, outer borders with small distal tubercles.

First three pairs of walking legs (P2-4; Figs 24a, 26a) very slender, with elongate meri, filiform propodi and dactyli. Upper and lower borders of meri with small, similarly pointed tubercles; distalmost tubercle on each anterior border much wider at base, higher, pointed tip directed distally. Anterior and posterior borders of carpi,

Source : MNHN, Paris

propodi, and dactyli of all walking legs (P2-4) entire, without tubercles (carpi and propodi of P3-4 with microscopic tubercles). P3-4 each with one dorsal carina each on carpus and propodus, one dorsal one ventral (very slight) carina on dactylus. Meri of all legs with numerous plumose setae; dorsal surfaces of carpi and propodi of P3-4 with rows of plumose setae; dorsal surface of dactyli of all legs each with one row of conspicuous plumose setae along anterior border.

First pair of walking legs (P2) much shorter and slender than second and third pairs (P3-4); third pair about as long as second pair. Fifth pair of pereopods (P5) short (0.8-0.9 CL), very slender; each merus with row of very low tubercles, conspicuous plumose setae along posterior border; each propodus with conspicuous plumose setae along posterior border; each dactylus with one spine on posterior border, plumose setae along anterior border, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.5-1.7	2.5-2.8	2.4-2.7	0.8-0.9
Merus length/CL	0.5-0.6	0.8-0.9	0.8-0.9	0.2-0.3
Dactylus length/Cl	0.5	0.7	0.7	0.2

Abdomen of mature males (Fig. 24c) with segments 3-5 fused, two very low tubercles (plus central prominence) on segment 3, salient, triangular one on 4. Male first pleopods (Figs 24d-e) with helicoidal distal parts, helicoidal, keel-like process along its length; each distal part curved, corneous (flexible but rigid) apex with sperm channel.

Abdomen of mature females with segments 3-5 fused. One ridge along each segment 1-2, two along proximal portion of fused segments 3-5 (most proximal one bordered by microscopic, blunt tubercles).

DISCUSSION. — The male first pleopods of *P. microphthalmus* are one of the most complex among the Indo-west Pacific species of palicids. Their general morphology is closest to that of *P. trispiralis* sp. nov., known only from the South China Sea and the Coral Sea.

The retina and the peduncle of the eyes are reduced in size in comparison to those of the other congeners. The orbits, however, remain wide and deep.

SIZE. — Maximum size among specimens examined: 7.8 x 12.0 mm (female, MNHN-B 26724); 7.3 x 11.4 mm (male paratype MNHN-B 26725).

ETYMOLOGY. — From *mikros*, Greek for small, and *ophthalmos*, Greek for eye, in reference to the diagnostic small eyes.

DISTRIBUTION. — Only known from off the northwest coast of Madagascar (Fig. 57). This and *P. elaniticus* are the only two species of *Parapalicus* known from the Indian Ocean. Both are known from very few specimens. Depth: 150 m.

Parapalicus nanshaensis Dai & Xu, 1991

Parapalicus nanshaensis Dai & Xu, 1991: 38, 46 [English], fig. 28.

TYPES. — *Holotype*: 1 ♀ 6.5 x 8.2 mm (DAI & XU, 1991), 7.05.1986 (Academia Sinica, Beijing).

TYPE LOCALITY. — West of Nansha (= Spratly) Islands, South China Sea, 07°02'N, 108°52'E, soft muddy bottom, 138 m.

DIAGNOSIS (after DAI & XU, 1991). — Carapace (DAI & XU, 1991, fig. 28-1) with triangular anterolateral tooth on each side. Supraorbital borders sinuous, each with one notch. Suborbital borders unknown. Dorsal border

Source : MNHN, Paris

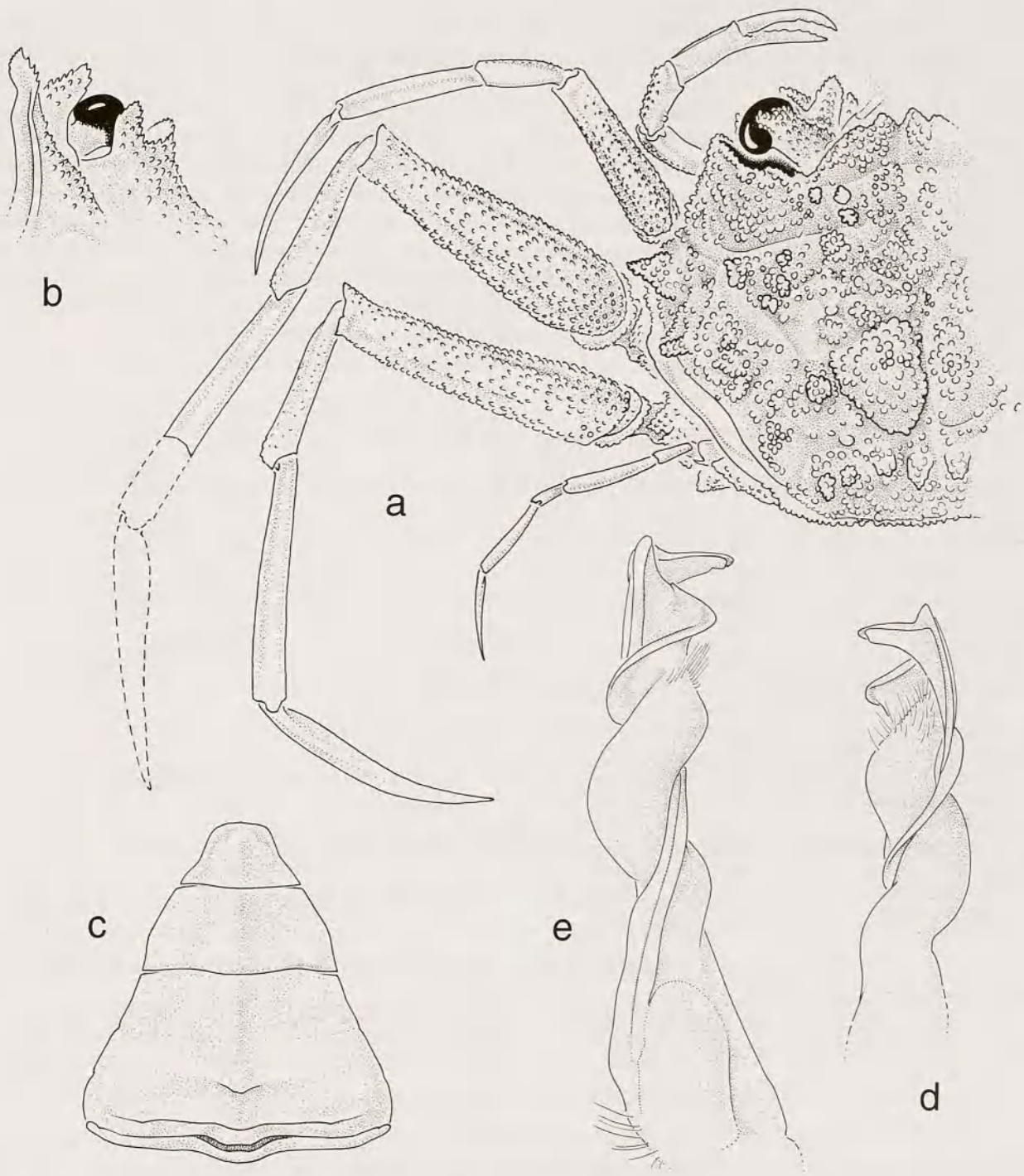


FIG. 24. — *Parapalicus microphthalmus* sp. nov.: **a-b**, ♀ holotype 7.8 x 11.2 mm, off northwest coast of Madagascar, 150 m (MNHN-B 26724): a, carapace and pereopods, dorsal surface; b, suborbital border. — **c-e**, paratype, 7.3 x 11.4 mm, off northwestern coast of Madagascar, 150 m (MNHN-B 26725); **c**, abdomen; **d**, left male first pleopod, lateral (inner side) view; **e**, left male first pleopod, ventral view.

of cheliped propodi (DAI & ZU, 1991, fig. 28-4) each with two low proximal tubercles; distal third of each finger with 3-4 short, closed-together teeth. Males unknown.

Source : MNHN, Paris

DISCUSSION. — *P. nanshaensis* was described from one female specimen. The description and the figures that accompany it did not give details of the morphology of the suborbital borders of the carapace that are needed for its proper comparison with other species. The holotype was not available for examination. No male specimens are known.

The chelipeds were described as smooth (DAI & XU, 1991: 46) but the dorsal border of each cheliped propodus is armed with two basal tubercles (DAI & XU, 1991, fig. 28-4). This is a characteristic shared with *P. ambonensis* (Fig. 16a), *P. elaniticus* (HOLTHUIS, 1977, fig. 3d), and *P. inanis* sp. nov. (Fig. 23c). *P. nanshaensis* can be clearly differentiated from *P. elaniticus*, which has supraorbital borders each with two notches and a rounded, lobe-like tubercle before the postorbital angle (HOLTHUIS, 1977, fig. 3a), and from *P. inanis*, which has a very small anterolateral tooth on each side of the carapace and notched frontal lobes. The carapace is similar to that of *P. ambonensis* and *P. trispiralis* sp. nov. (both having triangular anterolateral teeth that are pointed in an anterior direction; see Figs 16a, 27a) but the teeth on each finger of the chelipeds of *P. nanshaensis* are very different: triangular, blunt teeth that are closed together at the distal portion of each finger (DAI & XU, 1991, fig. 28-4), a character unique to the genus. Furthermore, each supraorbital border has only one slight notch in *P. nanshaensis*, but three in *P. ambonensis* (Fig. 16a).

SIZE. — Size of the female holotype: 6.5 x 8.2 mm (DAI & XU, 1991).

DISTRIBUTION. — Known only from near the Nansha (= Spratly) Islands in the South China Sea (DAI & XU, 1991). Depth: 138 m.

Parapalicus piruensis Moosa & Serène, 1981

Figs 25, 26b, 58

Parapalicus piruensis Moosa & Serène, 1981: 34, figs 2b, 3b, pl. 1, fig. C.

MATERIAL EXAMINED. — **Indonesia**. *Ceram.* MARIEL KING MEMORIAL EXPEDITION: stn CP I/1, Piru Bay, off Cape Tutuhuhur, 03°15'S, 128°08'E, 59-64 m, 1.06.1970: 1 ♀ holotype 4.7 x 6.3 mm (RDC CB2730).

Kai Islands. KARUBAR: stn DW 22, 05°22'S, 133°01'E, 85-124 m, 25.10.1991: 1 juv. ♂ (MNHN-B 26835).

New Caledonia. MUSORSTOM 4: Stn 203, 22°35.8'S, 167°04.8'E, 105-110 m, 27.09.1985: 1 juv. ♀ (MNHN-B 26836).

EXPÉDITION MONTROUZIER: Touho, 55-60 m, 7.09.1993: 1 ♀ (MNHN-B 26837); 55 m: 1 ♀ (MNHN-B 26838). — Koumac Channel, 49-63 m, 7.10.1993: 2 ♂ (MNHN-B 26760), 1 ♂ CL 3.6 mm (MNHN-B 26761).

Fiji. MUSORSTOM 10: stn CP 1358, 17°48.49'S, 178°46.70'E, 80-120 m, 13.08.1998: 2 ♂, 8 ♀, 1 juv. ♀ (MNHN-B 26759).

TYPES. — *Holotype*: 1 ♀ 4.7 x 6.3 mm, MARIEL KING MEMORIAL EXPEDITION, stn CP I/1 (RDC CB2730).

Paratype: 1 ♀ 3.2 x 4.2 mm (MOOSA & SERÈNE, 1981), Coronado Bay, Mindanao, Philippine Islands, sand and mud, 46-128 m, 10.11.1964 (RDC CB2728).

TYPE LOCALITY. — Off Cape Tutuhuhur, Piru Bay, Ceram, Indonesia, 03°15'S, 128°08'E, 59-64 m.

DIAGNOSIS. — Carapace (Fig. 26b; MOOSA & SERÈNE, 1981, fig. 2b) with small, triangular, anteriorly pointed anterolateral tooth on each side; dorsal surface covered with very small granules. Supraorbital borders sinuous, each with two notches. Suborbital borders each with wide, V-shaped gap between inner and outer suborbital lobes; outer lobe much smaller than inner lobe. Cheliped propodi smooth. Abdomen of mature males (Fig. 25a) with three very low, elongate tubercles on segment 3. Male first pleopods (Figs 25b-d) with sinuous basal parts; each distal part with two blunt, slightly curved tips. Abdomen of mature females with segments 3-5 fused; one very low transverse ridge on segment 3 (constricted twice medially); low ridge at each outer edge of segment 4.

Source : MNHN, Paris

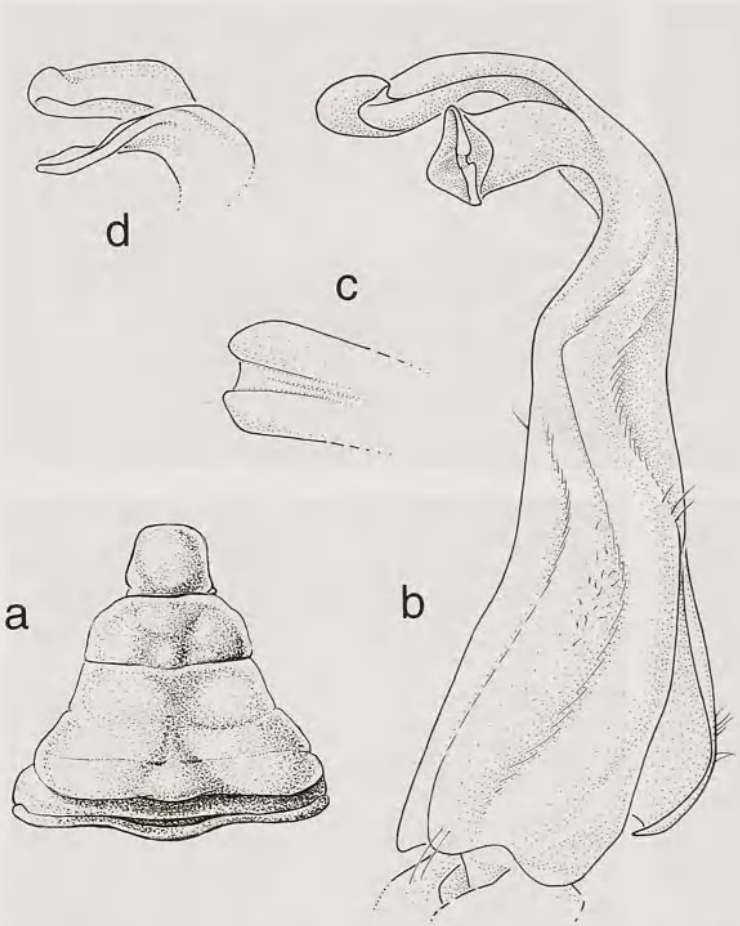


FIG. 25. — *Parapalicus piruensis* Moosa & Serène, 1981, ♂ CL 3.6 mm, Koumac Channel, New Caledonia, EXPÉDITION MONTROUZIER, 49-63 m (MNHN-B 26721): **a**, abdomen; **b**, left male first pleopod, lateral (inner side) view; **c**, apex, dorsal tip; **d**, apex.

Color: Specimens from Fiji that had been preserved for nine months after collection had irregular brown patches across the dorsal surface of the carapace and broad, vertical bands of the same color across the walking legs.

DISCUSSION. — The specimens that were examined in this study agree in most respects with the description of MOOSA & SERÈNE (1981), which was based on only two female specimens. It was short but it included relatively good (but incomplete) figures and a very poor photograph.

P. piruensis is characterized by a carapace that is only covered with small granules (Fig. 26b), short and acute anterolateral teeth that are anteriorly pointed, a very small outer suborbital lobe, and an almost smooth male abdomen (Fig. 25a). The total length of the second pair of walking legs (P3) of the specimens examined varied between 1.9-2.0 CL (merus 0.6-0.7 CL, dactylus 0.6 CL); total length of P4 2.0-2.1 CL (merus 0.6 CL, dactylus 0.6 CL).

This is the first time male specimens of *P. piruensis* have been examined and the male first pleopods described and illustrated (Figs 25b-d). The basal part is sinuous, not helicoidal as in most species of *Parapalicus*. As in *P. inanis* sp. nov. (Figs 23d-e), this appears to be the consequence of the short length of the pleopods.

SIZE. — Maximum size among the females examined: 6.7 x 7.4 mm (MNHN-B 26759); the largest of the males examined: 3.8 x 4.5 mm (MNHN-B 26760).

DISTRIBUTION. — MOOSA & SERÈNE (1981) recorded this species from the Sulu Sea (Mindanao, Philippine Islands) and Ceram Sea (Ceram, Indonesia). Its range (Fig. 58) is now extended to the Banda Sea (Kai Islands, Indonesia), Coral Sea (New Caledonia), and Fiji. Depth: known reliably between 55 and 105 m, collected too in trawls between 49-63 and 85-124 m.

Parapalicus trispiralis sp. nov.

Figs 27, 58

MATERIAL EXAMINED. — **Philippine Islands**. MUSORSTOM 1: stn 63, 14°00.8'N, 120°15.8'E, 191-195 m, 27.03.1975: 1 ♂ holotype 5.8 x 8.1 mm (MNHN-B 26727).

Loyalty Islands. MUSORSTOM 6: stn CP 419, 20°41.65'S, 167°03.70'E, 283 m, 16.02.1989: 1 ♀ paratype 7.3 x 9.5 mm (MNHN-B 26728).

Source : MNHN, Paris

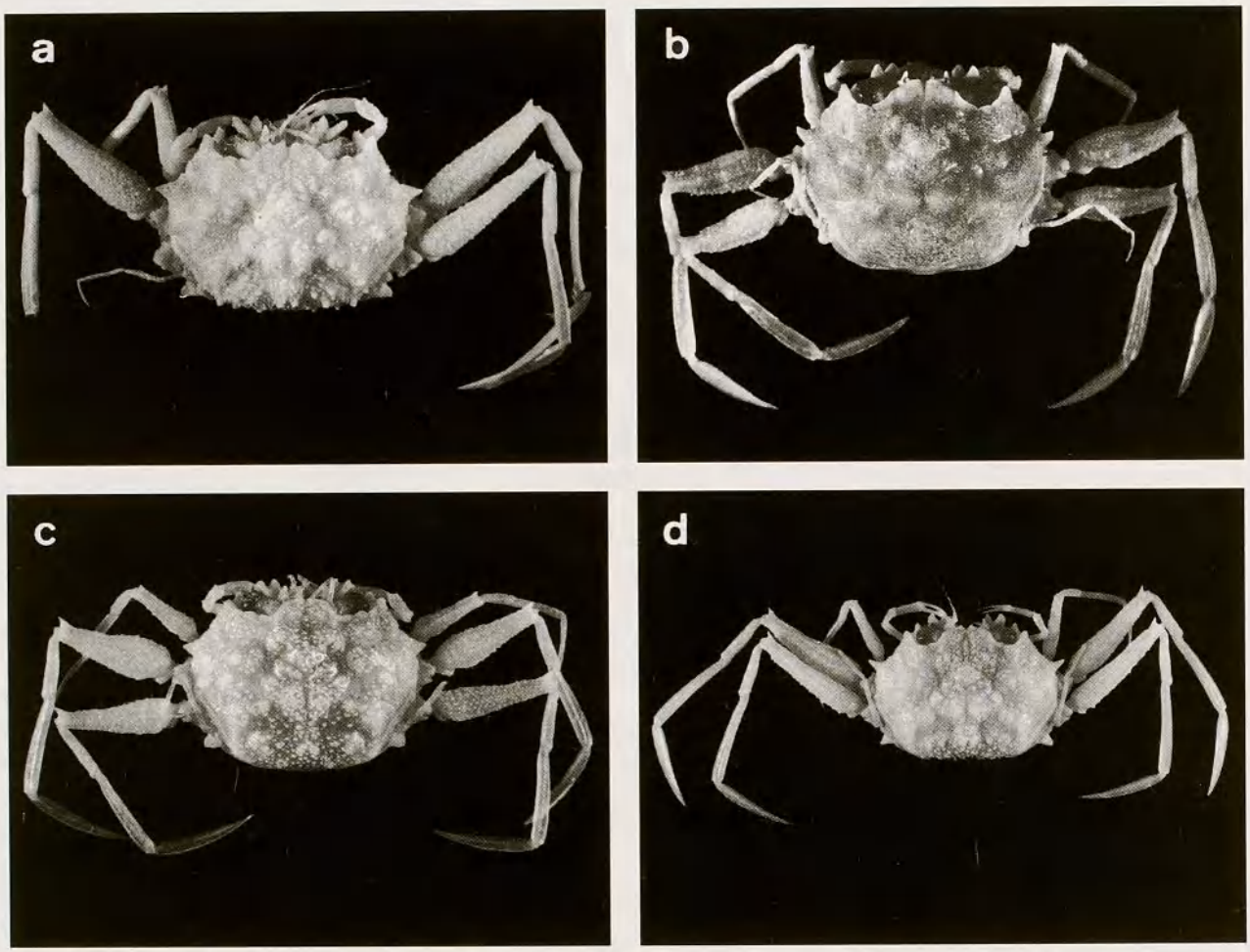


FIG. 26. — **a**, *Parapalicus microphthalmus* sp. nov., ♂ paratype 7.3 x 11.4 mm, off northwest coast of Madagascar, 150 m, A. CROSNIER coll. (MNHN-B 26725): dorsal view. — **b**, *Parapalicus piruensis* Moosa & Serène, 1981, ♀ 5.4 x 7.3 mm, Fiji, MUSORSTOM 10, stn CP 1358, 80-120 m (MNHN-B 26759): dorsal view. — **c**, *Parapalicus trituberculatus* (Chen, 1981): ♀ paratype 6.8 x 9.7 mm, South China Sea, stn 6028, 78 m (ZRC): dorsal view. — **d**, *Parapalicus unidentatus* (Zarenkov, 1968): ♀ 7.6 x 10.9 mm, South China Sea off the Philippine Islands, MUSORSTOM 3, stn CP 101, 194-196 m (MNHN-B 26998): dorsal view.

TYPES. — *Holotype*: 1 ♂ 5.8 x 8.1 mm, MUSORSTOM 1, stn 63 (MNHN-B 26727).
Paratype: 1 ♀ 7.3 x 9.5 mm, MUSORSTOM 6, stn CP 419 (MNHN-B 26728).

TYPE LOCALITY. — Off Luzon Island, Philippine Islands, 14°00.8'N, 120°15.8'E, 191-195 m.

DIAGNOSIS. — Carapace (Fig. 27a) with small, triangular anterolateral tooth on each side. Wide notch between two frontal lobes. Supraorbital borders each with three notches forming two small lobes. Suborbital borders (Fig. 27b) each with wide, V-shaped to nearly L-shaped gap between inner and outer suborbital lobes; outer lobe much smaller than inner lobe. Dorsal borders of cheliped propodi with microscopic teeth. Abdomen of mature males (Fig. 27d) with two conspicuous, triangular tubercles on segment 3, similar, larger one on segment 4. Male first pleopods (Figs 27e-f) with three coils when seen ventrally: helicoidal basal part, twice-helicoidal, tusk-shaped distal part. Abdomen of mature females with one transverse ridge along segment 3 (constricted medially); short ridge at each outer edge of segment 4.

DESCRIPTION. — Carapace (Fig. 27a) wider than long (CW/CL = 1.3-1.4); dorsal surface covered with small granules. Anterolateral borders of carapace each with small triangular, anteriorly-pointed tooth covered with fine

Source : MNHN, Paris

granules. Two small bosses, also covered with granules, on branchial region along border of carapace posterior to each tooth. Two conspicuous bosses on metagastric region. Episternal processes triangular. Posterior border of carapace with six slightly protuberant tubercles (more pronounced in female paratype) with rounded tips, few plumose setae.

Frontal border of carapace divided into two small lobes with triangular or slightly rounded tips, divided by wide V-shaped notch. Borders between frontal lobes and supraorbital borders rounded. Supraorbital borders each with

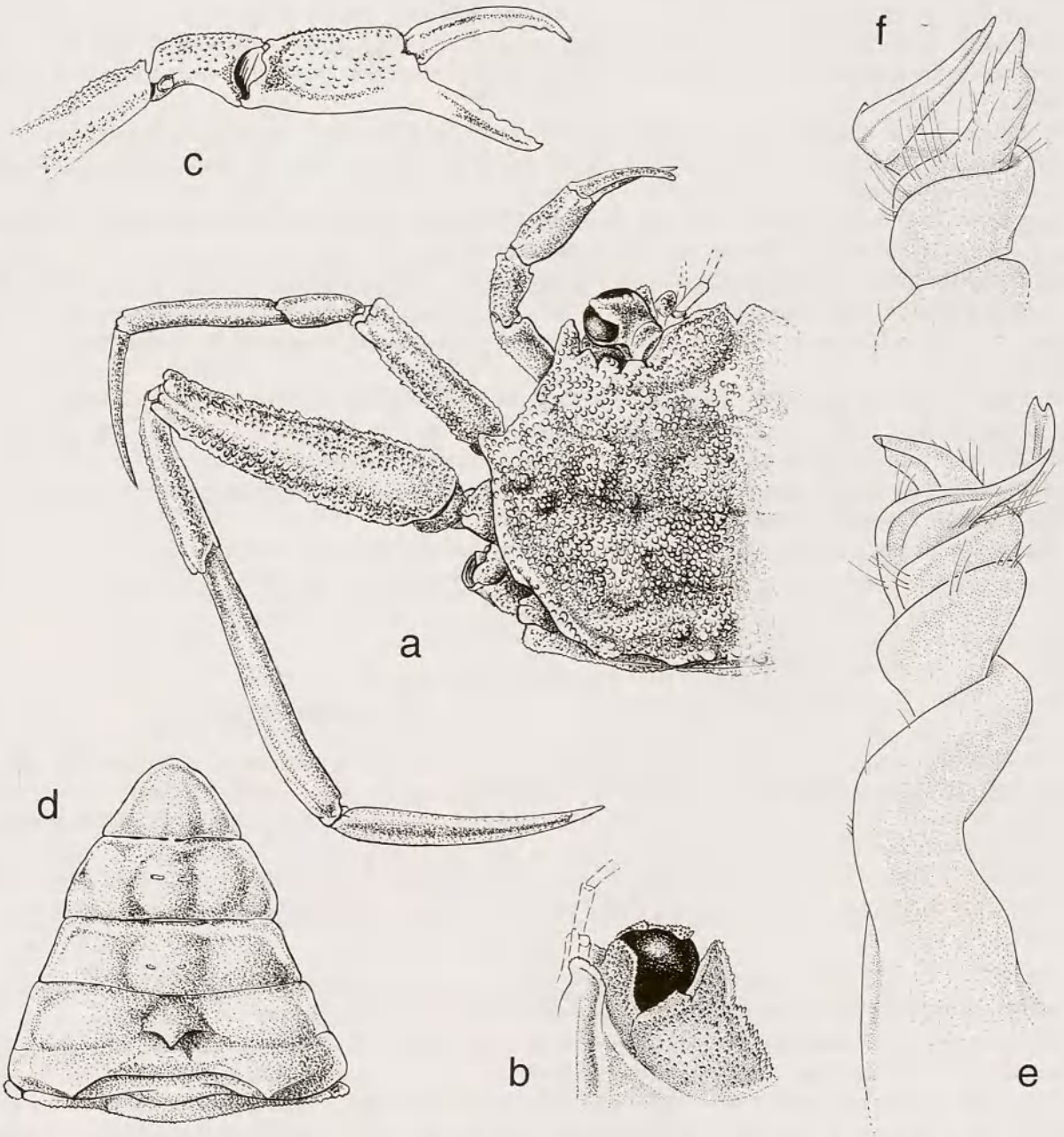


FIG. 27. — *Parapalicus trispiralis* sp. nov., ♂ holotype 5.8 x 8.1 mm, Philippine Islands, South China Sea, MUSORSTOM 1, stn 63, 191-195 m (MNHN-B 26727): **a**, carapace and pereopods, dorsal surface; **b**, suborbital border; **c**, right cheliped, outer surface; **d**, abdomen; **e**, left male first pleopod, ventral view; **f**, left male first pleopod, distal part, dorsal view.

Source : MNHN, Paris

three conspicuous notches, forming two small lobes. Postorbital angles short, pointed. Cornea of eyes dorsoventrally flattened, much wider than base of eye peduncle; each peduncle with two soft, low, distal tubercles.

Suborbital borders (Fig. 27b) each with wide, V-shaped to nearly L-shaped gap between inner and outer suborbital lobes. Outer lobe much smaller than pointed inner lobe. Pterygostomial lobes project slightly ventrally, rounded, shorter than each inner suborbital lobe.

Each basal antennal segment expanded distally as small, slightly pointed process; flagellum long, with conspicuous, simple setae. Inner border of ischia of third maxillipeds sinuous; surface with small granules, upper borders rounded. Meri much narrower than ischia; rounded, narrow upper border.

Dorsal borders of cheliped propodi with row of microscopic teeth (more conspicuous in female paratype). Distal third of each finger with 4-5 short, rounded teeth. Carpi short, outer borders each with low, broad tubercle across distal portion, small, pointed tubercles throughout; meri slender, outer borders with small, pointed tubercles.

First three pairs of walking legs (P2-4; Fig. 27a) very slender, with elongate meri, filiform propodi and dactyli. Upper and lower borders of meri with similar, low tubercles; distalmost tubercle on each anterior border much wider at base, with rounded tip directed distally. Anterior and posterior borders of carpi, propodi, and dactyli of all walking legs (P2-4) entire, without tubercles (propodi of P3-4 with microscopic tubercles). Each P2 with one dorsal carina on dactylus. Each P3 with one dorsal carina each on carpus, propodus, and dactylus. Each P4 with one dorsal carina on carpus and propodus; one ventral (very low) carina on propodus; dactylus unknown. Meri of all legs with scattered plumose setae; dorsal surfaces of carpi and propodi of P3-4 with rows of plumose setae; dorsal surface of dactyli of P2-3 each with one row of conspicuous plumose setae along anterior border; dactylus of P4 unknown.

First pair of walking legs (P2) much shorter and slender than second and third pairs (P3-4); third pair about as long as second pair. Fifth pair of pereopods (P5) short (0.8 CL), very slender; each merus with row of low tubercles, some provided with spine on posterior border, scattered plumose setae along anterior border; each propodus with two proximal spines on posterior border, scattered plumose setae along anterior border; dactylus with two spines on posterior border, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.5-1.6	2.8	-	0.8
Merus length/CL	0.4-0.5	0.8	0.8	0.2
Dactylus length/Cl	0.5	0.7	-	0.2

Abdomen of mature males (Fig. 27d) with segments 3-5 fused, two conspicuous, triangular tubercles on segment 3, similar but more salient one on segment 4. Male first pleopods (Figs 27e-f) with three coils when seen ventrally (helicoidal basal part, twice-helicoidal distal part with tusk-shaped tip); corneous, flexible apex with opening of sperm channel.

Abdomen of mature females with segments 3-5 fused. One ridge along each segment 1-2, one along proximal portion of fused segment 3-5 (ridge very slightly constricted twice medially); short ridge at each outer edge of segment 4.

DISCUSSION. — The description of *P. trispiralis* is based on only two specimens. Each of the measurements of the length of the walking legs was based on only one specimen, except for the second pair of legs (P2).

This species is close to *P. ambonensis* in that both species show conspicuous, triangular tubercles on the male abdomen. Characteristic of *P. trispiralis* is the presence of more conspicuous frontal lobes (formed by a wide median sulcus) and very small but clearly demarcated supraorbital lobes. Both of these features are characteristics of *Pseudopalicus* species. Nevertheless, the species clearly belongs to *Parapalicus* because of its helicoidal male first pleopods and the morphology of the carapace (only one anterolateral tooth), suborbital borders (tooth-like suborbital lobes), chelipeds (very slender and equal), walking legs (slender and long, smooth carpi, filiform propodi and dactyli; tubercles along borders of meri equal in size and shape), and shape of the male abdomen (triangular).

Source : MNHN, Paris

SIZE. — Size of the female paratype: 7.3 x 9.5 mm (MNHN-B 26728); male holotype: 5.8 x 8.1 mm (MNHN-B 26727).

ETYMOLOGY. — From *tres*, Latin for three, and *spiralis*, Latin for coil, in reference to the diagnostic arrangement of three coils or turns of the male first pleopods when seen ventrally.

DISTRIBUTION. — Known only from the South China Sea (off Luzon Island, Philippine Islands) and the Coral Sea (Loyalty Islands) (Fig. 58). Depth: 195-283 m.

Parapalicus trituberculatus (Chen, 1981)

Figs 26c, 28, 58

Palicus trituberculatus Chen, 1981: 465, pls 1, 2. — DAI *et al.*, 1986: 413, pl. 57, fig. 6.
Parapalicus marielae Moosa & Serène, 1981: 27, fig. 1, pl. 1, fig. A.
Palicus bidentatus Sakai, 1983: 630, fig. 3g-j.
Parapalicus trituberculatus - DAI & YANG, 1991: 450, pl. 57, fig. 6.

MATERIAL EXAMINED. — **South China Sea**. *"Albatross"*: stn 5302, southeast of Hong Kong, 21°42'N, 114°50'E, 69 m, mud, 9.08.1909: 1 ♀ holotype of *Palicus bidentatus* Sakai, 1983 CW 9.2 mm (USNM 195065).

Stn 6028, 22°00'N, 115°30'E, 78 m, soft mud, 14.04.1960: 2 ♂ paratypes 5.1 x 7.3 mm, 5.2 x 7.5 mm, 1 ♀ paratype 6.9 x 10.0 mm (ASIO); 2 ♂ paratypes 4.8 x 7.0 mm, 5.4 x 7.5 mm, 1 ♀ paratype 6.8 x 9.7 mm (ZRC 1999.1435-1437).

China. *Hainan Island.* 26.12.1955: 1 ♀ (ASIZB).

Viet Nam. *"Orlik"*: stn 206, Gulf of Tonkin, unknown depth, N.A. ZARENKOV coll., 12.07.1960: 1 ♂ 5.2 x 7.7 mm, 2 ♀ (MNHN-B 26807).

Philippine Islands. MUSORSTOM 1: stn 72, 14°11.8'N, 120°28.7'E, 127-122 m, 28.03.1976: 2 ♂ (MNHN-B 26808).

Indonesia. *Aru Islands.* MARIEL KING MEMORIAL EXPEDITION: stn AW 1/H 11-12, Wokam, west coast of Wasir Island, 05°30'S, 134°12'E, 73-91 m, 15.06.1970: 1 ♀ holotype of *Parapalicus marielae* Moosa & Serène, 1981, 5.0 x 7.1 mm (RDC CB2710).

TYPES. — *Holotype* of *Palicus trituberculatus* Chen, 1981: 1 ♂, South China Sea off China, 8.04.1960 (Institute of Oceanology, Academia Sinica, Qingdao, China; S209B-14).

Allotype of *Palicus trituberculatus* Chen, 1981: 1 ♀, South China Sea off China, 21°30'N, 115°30'E, 115 m, 13.04.1960 (Institute of Oceanology, Academia Sinica, Qingdao, China; S219B-23).

Paratypes of *Palicus trituberculatus* Chen, 1981: 1 ♂, 1 ♀, South China Sea off China, 21°00'N, 114°30'E, 83 m, 10.12.1959 (ASIO S143B-13); 2 ♂ paratypes 5.1 x 7.3 mm, 5.2 x 7.5 mm, 1 ♀ paratype 6.9 x 10.0 mm (ASIO); 2 ♂ paratypes 4.8 x 7.0 mm, 5.4 x 7.5 mm, 1 ♀ paratype 6.8 x 9.7 mm (ZRC 1999.1435-1437).

Holotype of *Parapalicus marielae* Moosa & Serène, 1981: 1 ♂ 5.0 x 7.1 mm, MARIEL KING MEMORIAL EXPEDITION, stn AW 1/H 11-12 (RDC CB2710).

Paratype of *Parapalicus marielae* Moosa & Serène, 1981: 1 ♀ 6.7 x 9.0 mm (MOOSA & SERÈNE, 1981). Same data as holotype (RDC CB2711).

Holotype of *Palicus bidentatus* Sakai, 1983: 1 ♀ CW 9.2 mm, *"Albatross"* Philippine Expedition, stn 5302 (USNM 195065).

TYPE LOCALITY. — South China Sea off China, 21°00'N, 114°30'E, 82 m.

DIAGNOSIS. — Carapace (Fig. 26c; CHEN, 1981, pl. 1) with triangular anterolateral tooth on each side. Supraorbital borders each with two slight notches. Suborbital borders (CHEN, 1981, pl. 2, fig. 1) each with very broad, almost circular gap between inner and outer suborbital lobes. Eye peduncles with numerous, small tubercles. Cheliped propodi (CHEN, 1981, pl. 2, fig. 2) with minute teeth. Abdomen of mature males (CHEN, 1981, pl. 2, fig. 4) with two slightly raised tubercles on segment 3, similar one on segment 4. Male first pleopods (Figs 28a-b; CHEN, 1981, pl. 2, figs 5-8; MOOSA & SERÈNE, 1981, fig. 1) with helicoidal basal parts; each distal part straight, pointed, bordered with minute teeth. Abdomen of mature females with one transverse ridge along each segment 1-4.

Source : MNHN, Paris

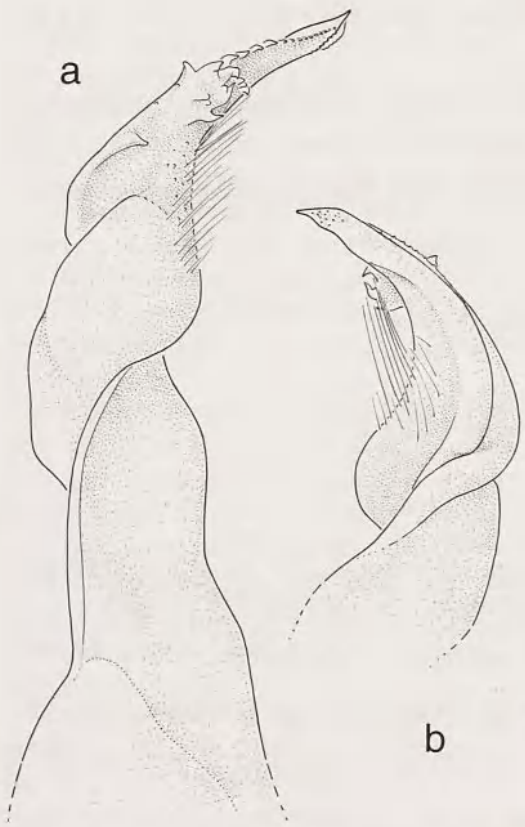


FIG. 28. — *Parapalicus trituberculatus* (Chen, 1981), ♂ 5.2 x 7.7 mm, Gulf of Tonkin, Viet Nam, unknown depth (MNHN-B 26807): **a**, left male first pleopod, ventral view; **b**, left male first pleopod, distal part, dorsal view.

DISCUSSION. — *P. trituberculatus* is similar to *P. clinodentatus* sp. nov. and *P. unidentatus* (Zarenkov, 1968) in the morphology of the dorsal surface of their carapaces, which are covered by granular bosses and have a triangular tooth and a blunt boss posterior to the anterolateral tooth. These two species can be differentiated from *P. trituberculatus* by the morphology of their male first pleopods (more complex in *P. clinodentatus* and *P. unidentatus*), the ornamentation of the cheliped propodi (a carina-like ornamentation present in *P. clinodentatus* and *P. unidentatus*), and the gaps between the inner and outer suborbital lobes (narrow and V-shaped in *P. clinodentatus* and *P. unidentatus*). *P. trituberculatus* also shares several characteristics with *P. denticulatus* sp. nov. (see contrast between the two species in the description of *P. denticulatus*).

The specimens that were examined agree with the paratypes that were available and the excellent figures given in its description (CHEN, 1981). The large boss posterior to the triangular tooth is referred to in the description as a tooth, hence the presence of "two teeth near the middle". The gap between the inner and outer suborbital lobes is described as V-shaped but it was wide and U-shaped in all specimens examined in this study as well as in the figure given in the original description (CHEN, 1981, pl. 2, fig. 1). The total length of the second pair of walking legs (P3) in the specimens that were measured varied between 2.1-2.4 CL (merus 0.6-0.7 CL, dactylus 0.6-0.7 CL); total length of P4 2.3 CL (merus 0.7 CL, dactylus 0.7 CL).

A comparison between the holotype of *Parapalicus marielae* Moosa & Serène, 1981 (RDC CB2710) and six paratypes of *Palicus trituberculatus* Chen, 1981 (ASIO; ZRC 1999.1435-1437) has clearly shown that they belong to the same species. The descriptions of both species were published in the same year but only that of CHEN (1981) gives an exact date: September 1981. Since the exact publication date of MOOSA & SERÈNE (1981) could not be determined, 31 December 1981 is adopted as its date of publication (International Code of Nomenclature, fourth edition, 1999, Article 21.3.2). It is then concluded that description of CHEN (1981) was published first and therefore the species should be referred to as *Parapalicus trituberculatus* (Chen, 1981). *P. marielae* is known from only two specimens. The description mentioned the presence of a "tooth" on the branchial region (MOOSA & SERÈNE, 1981: 29). This is undoubtedly a reference to the outermost of the one or two pairs of granular bosses present in that region of the carapace in many species of *Parapalicus*.

The examination of the holotype of *Palicus bidentatus* Sakai, 1983 has shown that it is identical to *P. trituberculatus*. SAKAI (1983) based his diagnosis on a flattened specimen without realizing it. Although the anterolateral teeth of the holotype are bent upward (and hence SAKAI's drawing showing two conspicuous "obtuse processes" with rounded tips representing the anterolateral tooth and the blunt boss posterior to it), the edge of the front folded over the carapace, and with only three walking legs and one cheliped remaining, all characters clearly agree with those of *P. trituberculatus*. The notches on the supraorbital border were incorrectly shown as forming three conspicuous lobes ("3 dorsal ... teeth") and the frontal lobes as having four, not two, lobes (SAKAI, 1983: 630, fig. 3g). Although some specimens of *P. trituberculatus* have slight notches on the frontal lobes, it was difficult to verify the morphology of the folded frontal lobes in the holotype of *P. bidentatus*. In addition, SAKAI's specimen was collected southeast of Hong Kong, not far from the type locality of *P. trituberculatus*.

Source : MNHN, Paris

SIZE. — Maximum size among specimens examined: 6.9 x 10.0 mm (female paratype, ASIO); 5.4 x 7.5 mm (male paratype, ZRC 1999.1435-1437).

DISTRIBUTION. — Known from the Gulf of Tonkin (off Viet Nam), in various locations of the South China Sea from off south China to the Philippine Islands (CHEN, 1981; SAKAI, 1983, as *Palicus bidentatus*), and the Arafura Sea (off Aru Islands), Indonesia (MOOSA & SERÈNE, 1981, as *Parapalicus marielae*) (Fig. 58). Depth: 69-122 m.

Parapalicus unidentatus (Zarenkov, 1968)

Figs 26d, 58

Palicus unidentatus Zarenkov, 1968: 763, figs 3A-Г.
Parapalicus unidentatus - MOOSA & SERÈNE, 1981: 32, fig. 4, pl. 1, fig. B.

MATERIAL EXAMINED. — **South China Sea**. *"Orlik"*: stn 211, off northern coast of Hainan, 60-180 m, 13.07.1960: 1 ♂, holotype (ZMMU Ma 5444). — Stn 203: *ibidem*, 60 m, 11.07.1960: 1 ♀, paratype (ZMMU Ma 5245).

Philippine Islands. MUSORSTOM 1: stn 14, 14°00.2'N, 120°17.2'E, 190 m, 20.03.1976: 1 ♂ (MNHN-B 27033). — Stn 20, 13°59.2'N, 120°20.3'E, 208-222 m, 21.03.1976: 1 ♀ (MNHN-B 27046). — Stn 24, 14°00.0'N, 120°18.0'E, 189-209 m, 22.03.1976: 3 ♀ (MNHN-B 27047). — Stn 26, 14°00.9'N, 120°16.8'E, 189 m, 22.03.1976: 1 ♂, 6 ♀ (MNHN-B 27048). — Stn 27, 13°59.8'N, 120°18.6'E, 192-188 m, 22.03.1976: 3 ♀ (MNHN-B 27049). — Stn 30, 14°01.3'N, 120°18.7'E, 186-177 m, 22.03.1976: 3 ♂, 1 ♀ (MNHN-B 27050). — Stn 31, 14°00.0'N, 120°16.0'E, 187-195 m, 22.03.1976: 3 ♀ (MNHN-B 27051). — Stn 32, 14°02.2'N, 120°17.7'E, 193-184 m, 23.03.1976: 3 ♀ (MNHN-B 27052). — Stn 35, 13°59.0'N, 120°18.5'E, 186-187 m, 23.03.1976: 1 ♀ (MNHN-B 27053). — Stn 55, 13°55.0'N, 120°12.5'E, 200-194 m, 26.03.1976: 1 ♀ (MNHN-B 27054). — Stn 56, 13°53.1'N, 120°08.9'E, 134-139 m, 26.03.1976: 1 ♂ 7.2 x 10.3 mm (MNHN-B 26763), 5 ♀ (MNHN-B 26762), 1 ♂ (MNHN-B 27055). — Stn 61, 14°02.2'N, 120°18.1'E, 202-184 m, 27.03.1976: 1 ♀ (MNHN-B 27056). — Stn 63, 14°00.8'N, 120°15.8'E, 191-195 m, 27.03.1976: 1 ♂, 2 ♀ (MNHN-B 27034). — Stn 64, 14°00.5'N, 120°16.3'E, 194-195 m, 27.03.1976: 1 ♂ (MNHN-B 27035). — Stn 71, 14°09.3'N, 120°26.2'E, 174-204 m, 28.03.1976: 6 ♀ (MNHN-B 27036).

MUSORSTOM 2: stn CP 1, 14°00'N, 120°19'E, 188-198 m, 20.11.1980: 1 ♀ (MNHN-B 27057). — Stn CP 2, 14°01'N, 120°17'E, 184-186 m, 20.11.1980: 1 ♀ (MNHN-B 27058). — Stn CP 10, 14°00'N, 120°18'E, 188-195 m, 21.11.1980: 3 ♀ (MNHN-B 27059). — Stn CP 11, 14°00'N, 120°19'E, 194-196 m, 21.11.1980: 3 ♀ (MNHN-B 27060). — Stn CP 12, 14°01'N, 120°20'E, 197-210 m, 21.11.1980: 1 ♀ (MNHN-B 27061). — Stn CP 18, 14°00'N, 120°18'E, 188-195 m, 22.11.1980: 4 ♂, 11 ♀ (MNHN-B 27037). — Stn CP 19, 14°00'N, 120°16'E, 189-192 m, 22.11.1980: 1 ♀ (MNHN-B 27062). — Stn CP 20, 14°00'N, 120°18'E, 185-192 m, 22.11.1980: 2 ♂, 7 ♀ (MNHN-B 27038). — Stn CP 21, 14°00'N, 120°17'E, 191-192 m, 22.11.1980: 2 ♀ (MNHN-B 27062). — Stn CP 51, 14°00'N, 120°17'E, 170-187 m, 27.11.1980: 1 ♀ (MNHN-B 27063). — Stn CP 62, 14°00'N, 120°17'E, 186-189 m, 29.11.1980: 2 ♀ (MNHN-B 27064). — Stn CP 64, 14°01'N, 120°19'E, 191-195 m, 29.11.1980: 6 ♀ (MNHN-B 27065). — Stn CP 67, 14°01'N, 120°19'E, 193-199 m, 29.11.1980: 1 ♂, 6 ♀ (MNHN-B 27039). — Stn CP 68, 14°01'N, 120°18'E, 195-199 m, 29.11.1980: 1 ♂, 7 ♀ (MNHN-B 27040). — Stn CP 71, 14°00'N, 120°18'E, 189-197 m, 30.11.1980: 1 ♀ (MNHN-B 27066). — Stn CP 72, 14°00'N, 120°18'E, 182-197 m, 30.11.1980: 2 ♂, 3 ♀ (MNHN-B 27041).

MUSORSTOM 3: stn CP 86, 14°00'N, 120°18'E, 187-192 m, 31.06.1985: 1 ♂ (MNHN-B 27042). — Stn CP 87, 14°00'N, 120°19'E, 191-197 m, 31.06.1985, 2 ♂, 19 ♀ (MNHN-B 27043). — Stn CP 88, 14°01'N, 120°17'E, 183-187 m, 31.05.1985, 1 ♂, 2 ♀ (MNHN-B 27067). — Stn CP 92, 14°03'N, 120°12'E, 224 m, 31.05.1985: 2 ♀ (MNHN-B 27068). — Stn CP 96, 14°00'N, 120°18'E, 190-194 m, 1.06.1985: 3 ♀ (MNHN-B 27069). — Stn CP 97, 14°00'N, 120°18'E, 189-194 m, 1.06.1985: 1 ♂, 2 ♀ (MNHN-B 27044). — Stn CP 100, 14°00'N, 120°18'E, 189-199 m, 1.06.1985, 14 ♀ (MNHN-B 27070). — Stn CP 101, 14°00'N, 120°19'E, 194-196 m, 1.06.1985: 9 ♀ (MNHN-B 26998). — Stn CP 103, 14°00'N, 120°18'E, 193-200 m, 1.06.1985: 1 ♀ (MNHN-B 27071). — Stn CP 108, 14°01'N, 120°18'E, 188-195 m, 2.06.1985: 1 ♂, 8 ♀ (MNHN-B 27045). — Stn CP 109, 14°00'N, 120°18'E, 190-198 m, 2.06.1985: 2 ♀ (MNHN-B 27072). — Stn CP 111, 14°00'N, 120°18'E, 193-205 m, 2.06.1985: 2 ♀ (MNHN-B 27073). — Stn CP 112, 14°00'N, 120°18'E, 187-199 m, 2.06.1985: 3 ♀ (MNHN-B 27074).

Semirara Islands. MUSORSTOM 3: stn CP 120, 12°06'N, 121°15'E, 219-220 m, 3.06.1985: 18 ♀ (MNHN-B 27075). — Stn CP 121, 12°08'N, 121°18'E, 73-84 m, 3.06.1985: 1 ♀ (MNHN-B 27076).

Indonesia. *Strait of Makassar*. CORINDON: stn CH 267, 01°56'S, 119°17'E, 134-186 m, 7.11.1980: 4 ♂, 1 ♀ (MNHN-B 27032).

Tanimbar Islands. KARUBAR: stn CP 65, 09°14'S, 132°27'E, 176-174 m, 1.11.1991: 2 ♀ (MNHN-B 27077).

TYPES. — *Holotype*: 1 ♂ CL 6.0 mm, *"Orlik"*, stn 213 (ZMMU Ma 5444). *Paratype*: 1 ♀ CL 7.2 mm, *"Orlik"*, stn 203 (ZMMU Ma 5245).

Source : MNHN, Paris

TYPE LOCALITY. — Off northeast coast of Hainan Island, China, South China Sea, 60-180 m.

DIAGNOSIS. — Carapace (Fig. 26d; ZARENKOV, 1968, fig. 3A) with triangular anterolateral tooth on each side. Supraorbital borders each with two notches. Suborbital border (ZARENKOV, 1968, fig. 3B) each with narrow, V-shaped gap between inner and outer suborbital lobes. Cheliped propodi with carina-like row of irregular tubercles; two additional rows of low tubercles along outer surface below. Abdomen of mature males (ZARENKOV, 1968, fig. 3б) with two slightly raised tubercles on segment 3, similar one on segment 4. Male first pleopods (ZARENKOV, 1968, fig. 3Г; MOOSA & SERÈNE, 1981, fig. 4) with helicoidal basal parts; each distal part with two equal, pointed tips that cross each other. Abdomen of mature females with one transverse ridge along segments 1-4.

DISCUSSION. — The chelipeds were described by ZARENKOV (1968: 763) as having "two long rows... of granules". When observed from the inner side, however, the dorsal row was in the shape of a carina-like row of irregular tubercles. The abdomen of all but one of the mature males that were examined in this study followed the figure of ZARENKOV (1968, fig. 3б). In the largest male (MNHN-B 26763), however, the tubercles are pointed. The morphology of their male first pleopods agrees in general terms with the schematic figure of ZARENKOV (1968, fig. 3Г) and with the holotype. It agrees more closely with the more detailed figure of MOOSA & SERÈNE (1981, fig. 4) except that the two tusk-shaped tips as well as the corneous apex are shorter in their figure than in most of the many specimens that were examined. In some specimens the tips were slightly curved distally.

The material that was examined also agrees with the diagnosis of MOOSA & SERÈNE (1981: 32), who also studied some of the MUSORSTOM 1 material from the Philippine Islands examined during this investigation. One exception is their statement that there is only one "shallow excavation" on the supraorbital borders. The male abdomen is described as having two "lobes" on segment 3 but a "triangular lobe" on segment 4. They only examined two males, however.

The total length of the second pair of walking legs (P3) in the measured specimens was 2.7 CL (merus 0.8-0.9 CL, dactylus 0.7 CL); total length of P4 2.7-2.8 CL (merus 0.9 CL, dactylus 0.7 CL).

P. unidentatus may be confused with *P. denticulatus* sp. nov. and *P. trituberculatus* sp. nov. because in the three species the dorsal surfaces of the carapace are covered by granular bosses and have a triangular anterolateral tooth with a blunt boss posterior to it. *P. unidentatus* may be separated from *P. denticulatus* by the morphology of its male first pleopods (much simpler in *P. denticulatus*, which has a single blade-like distal part; Fig. 20e), the ornamentation of the cheliped propodi (microscopic teeth in *P. denticulatus*; Fig. 20c), and the gap between the inner and outer suborbital lobes (broad and U-shaped in *P. denticulatus*; Fig. 20b). *P. unidentatus* can be separated from *P. trituberculatus* also by the morphology of its male first pleopods (only a blade-like distal part bordered by minute teeth in *P. trituberculatus*; Fig. 28a-b), the ornamentation of the cheliped propodi (microscopic teeth in *P. trituberculatus*) and the gaps between the inner and outer suborbital lobes (very broad and U-shaped in *P. trituberculatus*; CHEN, 1981, pl. 2, fig. 1).

SIZE. — Maximum size among specimens examined: 9.7 x 12.5 mm (female, MNHN-B 26762); 7.2 x 10.3 mm (male, MNHN-B 26763).

DISTRIBUTION. — Recorded from several locations in the South China Sea (ZARENKOV, 1968; MOOSA & SERÈNE, 1981). Its distribution is now extended to the Strait of Makassar and Arafura Sea (off Tanimbar Islands) in Indonesia (Fig. 58). Depth: known reliably between 84 and 220 m; also collected in trawl between 73-84 m.

Genus ***MIROPALICUS*** nov.

TYPE SPECIES. — *Palicus vietnamensis* Zarenkov, 1968. Gender: masculine.

DIAGNOSIS. — Frontal border of carapace divided into two small lobes. Anterolateral borders each with several rounded teeth. Dorsal surface of carapace with small granules and granular bosses. Eyes dorsoventrally flattened,

Source : MNHN, Paris

much wider than peduncle; peduncle with small, soft tubercles. Supraorbital borders each with two very short lobes. Suborbital borders each limited by conspicuous, rounded pterygostomial lobe (inner suborbital lobe much reduced, compressed on inner edge of border by pterygostomial lobe), short outer lobe. Each basal antennal segment rectangular, slender, without distal expansion. Epistome narrow (not expanded dorsoventrally), vertically inclined; two median teeth. Chelipeds increasingly unequal with increasing body size (particularly in males), smallest typically more slender in females. First three pairs of walking legs (P2-4) very slender, with elongate meri, filiform (long and very narrow) carpi, propodi, and dactyli. First pair (P2) much shorter than second pair (P3), but second pair only slightly longer than third pair (P4). Borders of meri of P2-4 with nearly equal tubercles. Distal, posterior borders of propodus and proximal, posterior borders of dactylus of P4 with short spines. Fifth pair of pereopods (P5) reduced (0.8-0.9 CL), very slender. Abdomen of mature males elongate (sides almost parallel to each other), with all segments free, one transverse ridge each along some segments. Male first pleopods long, slender; basal parts straight; each distal part thick, uniramous. Abdomen of mature females with all segments free, one transverse ridge along each segment 1-4.

DESCRIPTION. — Carapace transversely subovate, much broader than long, covered with conspicuous granules, some which are grouped into bosses. Confluence of branchial and mesogastric regions depressed, smooth. Sulcus between hepatic and branchial regions. Anterolateral borders of carapace rounded, with rounded teeth and bosses. Thoracic sternite 7 with reduced process (episternal process) at each outer edge and posterior to insertion of fifth pair of pereopods (P5), visible dorsally as narrow, rounded process.

Frontal border divided into two small lobes. Supraorbital borders each with two very short lobes. Postorbital angles long with rounded tips. Cornea of eyes dorsoventrally flattened, much wider than base of eye peduncle (reniform); peduncle with soft tubercles. Orbits deep, wide.

Suborbital borders very wide, each limited by conspicuous, ventrally projecting, rounded pterygostomial lobe on inner edge (inner suborbital lobe reduced, compressed by pterygostomial lobe), rounded, short outer lobe.

Each basal antennal segment rectangular, slender; flagellum long with conspicuous setae. Epistome narrow, not expanded dorsoventrally, vertically inclined. Border of epistome with two median teeth plus two triangular outer processes connecting distally with pterygostomial lobe. Meri of third maxillipeds narrower than ischia.

Chelipeds increasingly unequal with increasing size (particularly in males), smallest more slender in females. Fingers of larger cheliped with cutting edge or teeth; those of smaller cheliped with teeth, pollex becoming flatter with increasing size. Dorsal and outer borders of cheliped propodi with conspicuous tubercles. First three pairs of walking legs (P2-4) very slender, with elongate meri, filiform (long and very narrow) carpi, propodi, and dactyli. Upper and lower borders of meri with equal or nearly equal tubercles; carpi entire, without teeth; row of spines along posterior borders of propodi and dactyli of third pair of walking legs (P4). First pair of walking legs (P2) much shorter, slender than second pair (P3); third pair (P4) much shorter than second pair but only slightly shorter than first pair. Last two pairs of walking legs (P3-4) each with slightly broadened coxae, having slightly flattened, thick-edged anterior and posterior borders. Fifth pairs of pereopods (P5) reduced (0.8-0.9 CL), very slender; basis-ischia slender, smooth; many short spines along posterior border of dactyli, some on propodi.

Abdomen of mature males elongate, with both sides almost parallel to each other, with all segments free, segments 1-2 dorsoventrally compressed, one transverse ridge each along some segments. Male first pleopods long, slender; basal parts straight; each distal part uniramous. Second male pleopods short, thin, slightly curved; distal segment with blunt tip.

Abdomen of mature females broad, rounded, with all segments free, one transverse ridge along each segment 1-4. Abdomen of immature females triangular (but broader than in males), segments 1-2 dorsoventrally compressed, segments 3-6 fused, transverse ridge along each segment 1-4.

SPECIES INCLUDED. — Only one species is so far known, *M. vietnamensis* (Zarenkov, 1968).

SEXUAL DIMORPHISM. — Females attain a larger size than males. The chelipeds are unequal in size in both sexes but the difference is more apparent in males. The smallest cheliped is usually more slender in females. There is no evidence of differences in the length or shape of the walking legs or fifth pair of pereopods.

Source : MNHN, Paris

DISCUSSION. — The genus is erected for one species that has unique characteristics while sharing some with *Pseudopalicus* and others with *Parapalicus* (see Table 1).

ZARENKOV (1968: 763) commented on the unusual length of the second pair of walking legs (P3) of his new species, *Palicus vietnamensis* Zarenkov, 1968. He pointed out that this character was mostly present in the American species of palicids but that there were differences in the respective suborbital borders, a reference to the very broad suborbital border of the new species. It was placed, like most other species of palicids known at that time, in *Palicus* Philippi, 1838. MOOSA and SERÈNE (1981) provisionally included the species in their new genus, *Parapalicus*. They did not examine any specimens, but commented that the narrow abdomen of the males was very different from the triangular abdomen of *Parapalicus*, which "probably be restricted to species with broad abdomen only" (MOOSA & SERÈNE, 1981: 26).

Characters that *Miropalicus* shares with *Parapalicus* are the morphology of the legs (long and filiform, with equal or nearly equal tubercles along the borders of the meri, smooth borders of the carpi, propodi, and dactyli, and very slender P5, with smooth, slender basis-ischia), granular carapace, frontal border with two lobes, elongate cheliped fingers, and dorsoventrally flattened eyes that are much wider than the peduncle (reniform eyes). Characteristic of *Pseudopalicus* are the narrow shape of the male abdomen, a female abdomen with all segments free and transverse ridges along segments 1-4, general shape of the carapace (more quadrate than oval, long and conspicuous postorbital angles), greatly reduced episternal processes, unequal chelipeds, narrow and elongate epistome provided with teeth, and slender basal antennal segments.

Unique characters of *Miropalicus* are the presence of a third pair of walking legs (P4) that is only slightly longer than the first pair (P2) (markedly longer than P2 in *Pseudopalicus* and *Parapalicus*), spines along the posterior border of both propodi and dactyli of P4, male first pleopods with straight basal parts and thick distal parts each with a nearly square tip, and a seemingly enlarged orbit with hardly any lobes or teeth along both supraorbital and suborbital borders, the reduced inner suborbital lobe being dwarfed by the very large pterygostomial lobe. The coxae of P2-4, slightly expanded into thick anterior and posterior edges, are somewhat intermediate between those of *Pseudopalicus* (thin, expanded edges) and *Parapalicus* (smooth, rounded edges).

ZARENKOV (1968: 765) allied *M. vietnamensis* (together with *Palicus hatusimaensis* Sakai, 1963) with RATHBUN's group 2 of the western Atlantic species of *Palicus* (RATHBUN, 1918: 184) on account of its very long walking legs. This group consists of five species: *P. acutifrons* (A. Milne Edwards, 1880), *P. cursor* (A. Milne Edwards, 1880), *P. floridanus* (Rathbun, 1918), *P. gracilis* (Smith, 1883), and *P. gracilipes* (A. Milne Edwards, 1880). Indeed, *M. vietnamensis* has striking superficial similarities with *P. cursor*. Both species have very long walking legs, the third walking legs (P4) are conspicuously shorter than the second (P3), and there are three anterolateral teeth. *P. cursor*, however, has a triangular male abdomen with at least one conspicuous tubercle, and the carapace has four anterior lobes, a large, triangular outer suborbital tooth, and well-developed supraorbital lobes. There are also superficial similarities with *P. gracilipes* (A. Milne Edwards, 1880), but as in *P. cursor*, this species has a triangular male abdomen with three tubercles similar to that of *Parapalicus*. Thus, similarities with RATHBUN's group 2 are only superficial and none of these five species conform with the characters used in the definition of *Miropalicus*.

ETYMOLOGY. — From *mirus*, Latin for wonderful or strange, and the generic name *Palicus*, in reference to the wide orbits without conspicuous lobes, which make the eyes look unusually large, and the unusually long and graceful walking legs.

Miropalicus vietnamensis (Zarenkov, 1968)

Figs 29, 30a, 59, 60f

Palicus vietnamensis Zarenkov, 1968: 762, fig. 2A-Г.
Parapalicus vietnamensis - MOOSA & SERÈNE, 1981: 26, 27 (in key).

MATERIAL EXAMINED. — **South China Sea**. *"Orlik"*, Vietnam, 300-350 m: 1 ♂, holotype (ZMMU Ma 5248).

Source : MNHN, Paris

Philippine Islands. MUSORSTOM 2: stn CP 83, 13°55'N, 120°30'E, 318-320 m, 2.12.1980: 1 ♀ (MNHN-B 27159).

Indonesia. *Tanimbar Islands*. KARUBAR: stn ED 68, 08°54'S, 132°01'E, 280-296 m, 1.11.1991: 1 ♀ (MNHN-B 27160). — Stn CP 79, 09°16'S, 131°22'E, 250-239 m, 3.11.1991: 5 ♂, 18 ♀ (MNHN-B 26765). — Stn CP 83, 09°23'S, 131°00'E, 285-297 m, 4.11.1991: 2 ♂, 7 ♀ (MNHN-B 27157). — Stn CP 84, 09°23'S, 131°09'E, 275-246 m, 4.11.1991: 3 ♂, 15 ♀ (MNHN-B 27158). — Stn CP 85, 09°22'S, 131°14'E, 245-240 m, 4.11.1991: 1 ♂ 7.8 x 9.7 mm (MNHN-B 26809).

Vanuatu. MUSORSTOM 8: stn CP 980, 19°21'S, 169°25'E, 450-433 m, 22.09.1994: 1 ♀ (MNHN-B 27161).

New Caledonia. MUSORSTOM 4: stn 236, 22°11.30'S, 167°15.00'E, 495-550 m, 2.10.1985: 1 ♂, 1 ♀ (MNHN-B 27162). — Stn 239, 22°14.80'S, 167°15.70'E, 470-475 m, 2.10.1985: 1 ♀ (MNHN-B 27163). — Stn 241, 22°09.00'S, 167°12.20'E, 470-480 m, 3.10.1985: 1 ♂, 1 ♀ (MNHN-B 27164). — Stn 243, 22°02.80'S, 167°07.70'E, 435-450 m, 3.10.1985: 1 ♀ (MNHN-B 27165).

BATHUS 1: stn CP 656, 21°13'S, 165°53'E, 452-460 m, 12.03.1993: 3 ♀ (MNHN-B 27166). — Stn CP 657, 21°14'S, 165°54'E, 490-530 m, 12.03.1993: 1 ♂, 1 ♀ (MNHN-B 27167). — Stn CP 698, 20°34'S, 164°57'E, 491-533 m, 17.03.1993: 2 ♂ (MNHN-B 27168).

BATHUS 2: stn CP 738, 23°02'S, 166°56'E, 558-647 m, 13.05.1993: 1 ♀ (MNHN-B 27169). — Stn CP 742, 22°33'S, 166°25'E, 340-470 m, 14.05.1993: 1 ♀ (MNHN-B 27170). — Stn CP 761, 22°18'S, 166°10'E, 490-500 m, 16.05.1993: 1 ♂ (MNHN-B 27171). — Stn CP 770, 22°09'S, 166°04'E, 400-402 m, 18.05.1993: 1 ♀ (MNHN-B 27172).

HALIPRO 1: stn CP 868, 21°14'S, 165°55'E, 430-550 m, 23.03.1994: 1 ♂, 1 ♀ (MNHN-B 27173). — Stn CP 869, 21°14'S, 165°55'E, 450-490 m, 23.03.1994: 2 ♂, 1 ♀ (MNHN-B 27174).

BATHUS 4: stn DW 888, 21°00'S, 164°27'E, 430-436 m, 2.08.1994: 1 ♀ (MNHN-B 27175). — Stn CP 899, 20°16'S, 163°50'E, 500-600 m, 3.08.1994: 2 ♂, 2 ♀ (MNHN-B 26995).

Loyalty Islands. MUSORSTOM 6: stn DW 410, 20°38.05'S, 167°06.65'E, 490 m, 15.02.1989: 1 ♂ (MNHN-B 27176). — Stn CP 415, 20°40.20'S, 167°03.95'E, 461 m, 15.02.1989: 1 ♂ (MNHN-B 27177). — Stn DW 428, 20°23.54'S, 166°12.57'E, 420 m, 17.02.1989: 1 ♀ 10.5 x 14.8 mm (MNHN-B 26764). — Stn CP 467, 21°05.13'S, 167°32.11'E, 575 m, 21.02.1989: 1 ♂ (MNHN-B 27178).

TYPES. — *Holotype* : 1 ♂ CL 7.2 mm, *"Orlik"*, off Viet Nam (ZMMU Ma 5248).

TYPE LOCALITY. — Off Viet Nam coast, South China Sea, 300-350 m.

DIAGNOSIS. — Carapace (Figs 29a, 30a, 60f; ZARENKOV, 1968, fig. 2A) with three rounded to slightly flattened anterolateral teeth on each side; teeth decrease in size posteriorly; 2-5 (usually four) rounded tubercles on branchial region posterior to anterolateral teeth. Supraorbital borders each with two very short lobes. Suborbital border (Fig. 29b; ZARENKOV, 1968, fig. 2B) very wide, limited by conspicuous, rounded, ventrally projecting pterygostomial lobe (inner suborbital reduced, compressed by pterygostomial lobe), small, rounded outer lobe. Dorsal and outer borders of cheliped propodi (ZARENKOV, 1968, fig. 2A) each with three rows of tubercles, more pronounced in slender chelipeds of females. Second pair of walking legs (P3) very long (3.5-4.0 CL), third pair (P4) short, only slightly longer than first pair (Figs 30a, 60f). Distal, posterior borders of propodi and proximal, posterior borders of dactyli of P4 (Fig. 29c) with short spines. Abdomen of mature males (Fig. 29d; ZARENKOV, 1968, fig. 2B) narrow, with all segments free; one complete transverse ridge along segments 1-3 and along median portion of segment 4. Male first pleopods (Figs 29e-f; ZARENKOV, 1968, fig. 2Γ) with straight basal parts; each distal part thick, with elongate, dorsal process with sperm channel, two ventral tubercles, one rounded, second pointed. Abdomen of mature females with all segments distinct, one transverse ridge along each segment 1-4 (very low ridge may be present on segment 5).

Color: A male from the Loyalty Islands photographed live (Fig. 60f) had a pink carapace with irregular yellow spots. The yellow spots on the nearly transparent walking legs and chelipeds may remain in specimens preserved for several years. The cornea of the eyes is light blue in live specimens.

DISCUSSION. — *M. vietnamensis* was placed by ZARENKOV (1968) in *Palicus* but MOOSA & SERÈNE (1981) provisionally placed it in their new genus *Parapalicus* (see discussion of *Miropalicus*).

The material examined in this study agrees with the description and figures of ZARENKOV (1968). There are, however, some exceptions. The male abdomen was described as having segments 3-4 fused and crossed by two ridges (ZARENKOV, 1968, fig. 2B). This characteristic, suggestive of a juvenile specimen, was not found in any of the specimens examined in this study. ZARENKOV's specimen, one of three males he examined, was certainly not a juvenile because of its size (CL 7.1 mm), which was close to the maximum size of the males examined in this

Source : MNHN, Paris

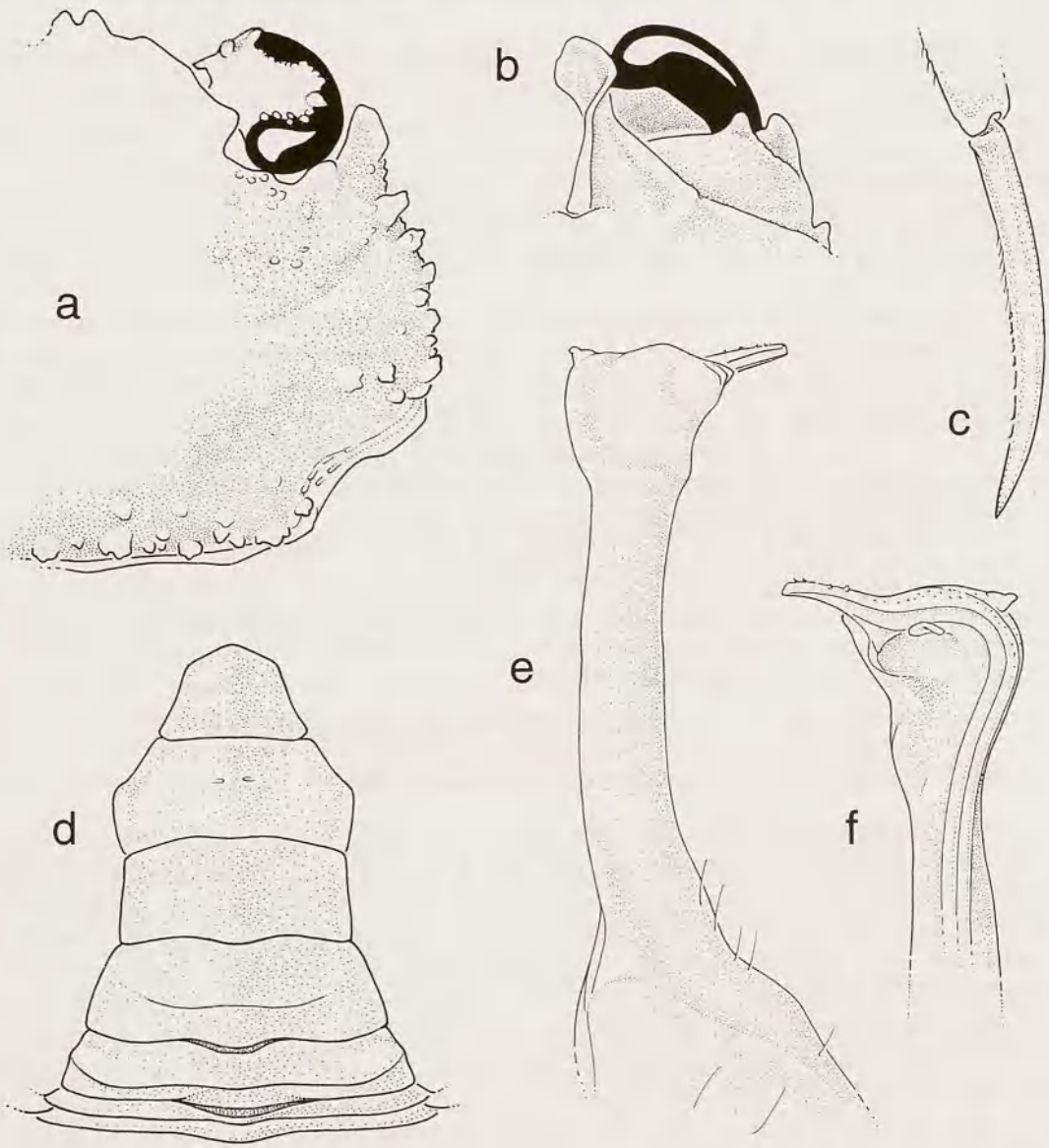


FIG. 29. — *Miropalicus vietnamensis* (Zarenkov, 1968), ♂ 7.8 x 9.9 mm, Tanimbar Islands, Arafura Sea, Indonesia, KARUBAR, stn CP 85, 245-240 m (MNHN-B 26809): **a**, carapace, dorsal view; **b**, suborbital border; **c**, dactylus, right fourth pereopod, dorsal view; **d**, abdomen; **e**, left first male pleopod, ventral view; **f**, left male first pleopod, distal part, dorsal view.

study. The examination of the male holotype (ZMMU Ma 5248) showed that contrary to ZARENKOV's drawings, the abdomen has all segments free and the first pleopods are as illustrated here (figs 29e-f).

There are rows of conspicuous plumose setae along both borders of the propodi and the anterior borders of the dactyli of P3-4. For the propodi, however, ZARENKOV (1968, fig. 2A), shows setae only along the posterior borders. No spines were indicated.

Characteristic of this species is the presence of 2-5 (usually four) high, rounded, granular bosses on the branchial region posterior to each anterolateral tooth. Although on the outer border of the branchial region, they are slightly above the border proper, and can be differentiated from the larger and often flatter anterolateral teeth. The most posterior of the bosses, the largest, is the first of typically 14 rounded bosses that cross the carapace along the branchial and cardiac regions.

Source : MNHN, Paris

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.4-1.6	3.5-4.0	1.8-1.9	0.8-0.9
Merus length/CL	0.5-0.6	1.2-1.4	0.6-0.7	0.2-0.3
Dactylus length/Cl	0.4-0.5	0.7-0.8	0.5	0.2

The fifth pair of pereopods (P5) has smooth, slender basis-ischia and meri (except a few microscopic tubercles along the posterior borders of the meri), each propodus with 2-7 spines along the posterior border, and each dactylus with 9-15 long, thick spines along the posterior border and two along the distal part of the anterior border in addition to a long terminal tooth.

SIZE. — Maximum size among specimens examined: 10.5 x 14.8 mm (female, MNHN-B 26764); 7.5 x 10.0 mm (male, MNHN-B 26765).

DISTRIBUTION. — Originally known only from the South China Sea (ZARENKOV, 1968), its distribution is now extended to the South China Sea (coast of the Philippine Islands), Arafura Sea (off Tanimbar Islands, Indonesia), and Coral Sea (Vanuatu, New Caledonia, and the Loyalty Islands) (Fig. 59). Depth: known reliably between 245 and 575 m; also collected in trawl between 558 and 647 m.

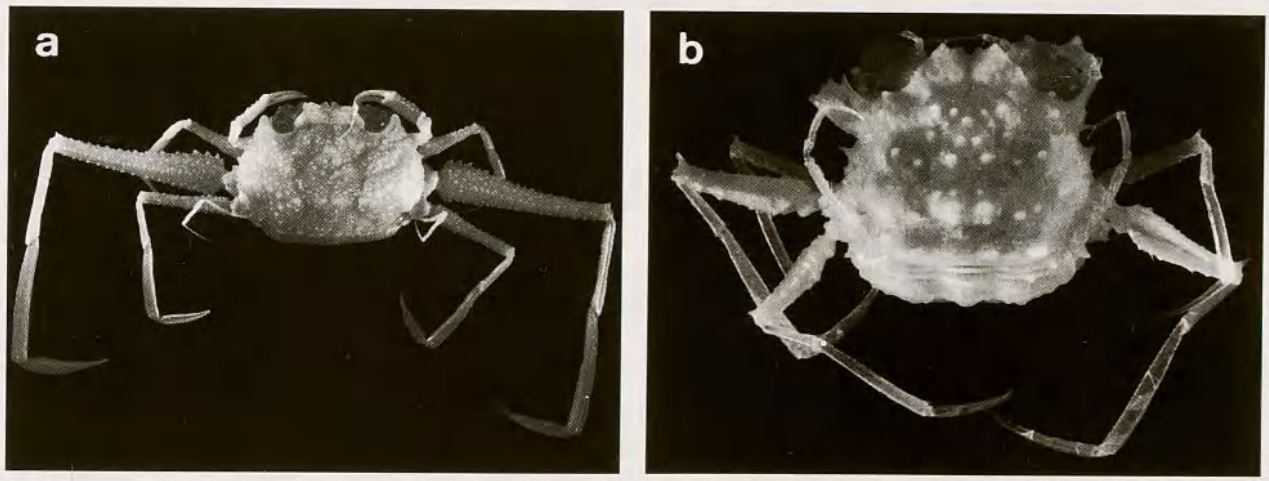


FIG. 30. — **a**, *Miropalicus vietnamensis* (Zarenkov, 1968): ♀ 10.7 x 15.5 mm, off northwest coast of New Caledonia, BATHUS 4, stn CP 899, 500-600 m (MNHN-B 26995): dorsal view. — **b**, *Paliculus kyusyuensis* (Yokoya, 1933): ♀ 3.1 x 3.5 mm, KARUBAR, stn DW 2, 209-240 m (MNHN-B 26770): dorsal view.

Genus ***PALICULUS*** nov.

TYPE SPECIES. — *Palicus kyusyuensis* Yokoya, 1933. Gender: masculine.

DIAGNOSIS. — Mature adults reach very small size. Frontal border of carapace divided into two small lobes. Anterolateral borders each with 1-4 pointed teeth. Dorsal surface of carapace with tubercles, few granular bosses. Eyes dorsoventrally flattened, much wider than peduncle; peduncle long with small, soft tubercles. Supraorbital borders each with 1-2 lobes. Suborbital borders broad, each limited by conspicuous pterygostomial lobe, 1-2 short lobes. Each basal antennal segment rectangular, slender, without distal expansion. Epistome narrow (not expanded dorsoventrally), vertically inclined; two median teeth. Chelipeds nearly equal but more unequal in males. First three pairs of walking legs (P2-4) very slender, with elongate meri and (with one exception) filiform (long and very

Source : MNHN, Paris

narrow) carpi, propodi, and dactyli. First pair (P2) much shorter than second pair (P3), but second pair only slightly longer than third pair (P4). Borders of meri of P2-4 with nearly equal tubercles; carpi, propodi, and dactyli entire. Fifth pair of pereopods (P5) reduced (0.9 CL), very slender. Abdomen of mature males elongate (sides almost parallel to each other), with all segments free, one transverse ridge along each segment 1-3. Male first pleopods with basal parts straight; each distal part biramous. Abdomen of mature females with segments 3-5 or 4-6 fused, one transverse ridge along each segment 1-3, one along fused segments 3-6 or 4-6.

DESCRIPTION. — Very small size (females ovigerous at less than CL 3.0 mm, reaching maximum known size of CL 5.0 mm). Carapace subquadrate, tuberculate. Anterolateral borders of carapace straight, with 1-4 pointed anterolateral teeth. Confluence of branchial and mesogastric regions depressed, smooth; sulcus between hepatic and branchial regions. Thoracic sternite 7 typically with process (episternal process) at each outer edge and posterior to insertion of fifth pair of pereopods (P5), visible dorsally as rounded to narrow, pointed process (more conspicuous in males).

Frontal border divided into two small lobes that may have recessed, pointed portion creating 4-lobe appearance. Supraorbital borders each with 1-2 lobes. Postorbital angles long, pointed tips, directed outward. Cornea of eyes dorsoventrally flattened, much wider than base of eye peduncle (reniform); peduncle long with soft tubercles. Orbits deep, wide.

Suborbital borders each limited by conspicuous, ventrally inclined, rounded pterygostomial lobe on inner edge (inner suborbital lobe reduced, compressed by pterygostomial lobe) and 1-2 rounded, short outer lobes. Ridge connecting each pterygostomial lobe with pterygostomial region with triangular tooth.

Each basal antennal segment rectangular, slender or slightly expanded; flagellum long with conspicuous setae. Epistome narrow, not expanded dorsoventrally, vertically inclined. Border of epistome with no apparent teeth or two short median teeth plus two narrow outer processes connecting distally with each pterygostomial lobe. Meri of third maxillipeds as wide as ischia.

Chelipeds increasingly unequal with increasing size (particularly in males), smallest more slender in females. Fingers of larger cheliped with cutting edge or teeth; those of smaller cheliped with teeth, pollex becoming flatter with increasing size. Dorsal borders of cheliped propodi with conspicuous tubercles. First three pairs of walking legs (P2-4) very slender, with elongate meri and (with one exception) filiform (long and very narrow) carpi, propodi, and dactyli. Upper and lower borders of meri with nearly equal (can be thin, rounded) tubercles; carpi entire, without teeth; borders of dactyli entire. First pair of walking legs (P2) much shorter and slender than second pair (P3); third pair (P4) slightly shorter than second pair. Fifth pairs of pereopods (P5) reduced (0.9 CL), very slender; basis-ischia slender and smooth; spines along posterior border of meri.

Abdomen of mature males elongate, with both sides almost parallel to each other, with segments free, segments 1-2 dorsoventrally compressed, one complete transverse ridge along each segment 1-3, incomplete along segment 4. Male first pleopods long, slender; basal parts straight; each distal part biramous. Second male pleopods short, thin, slightly curved; distal segment with blunt tip.

Abdomen of mature females broad, rounded, segments 1-2 dorsoventrally compressed, segments 3-5 or 4-6 fused, one transverse ridge along each segment 1-3, proximal portion of fused segment. Abdomen of immature females triangular (but broader than in males), segments 1-2 dorsoventrally compressed, 3-6 fused, transverse ridge along each segment 1-4.

SPECIES INCLUDED. — Three species are known: *P. foliatus* sp. nov., *P. kyusyuensis* (Yokoya, 1933), and *Paliculus* sp., an undescribed species known from only one incomplete specimen.

SEXUAL DIMORPHISM. — As in other Indo-west Pacific palicids, females are larger in size than males. The chelipeds are slightly unequal in size in both sexes but the difference is more apparent in males. There is no evidence of sexual dimorphism in the relative length of pereopods.

DISCUSSION. — *Paliculus* (with the exception of *P. foliatus* sp. nov.) shares with *Parapalicus* and *Miropalicus* elongate, filiform walking legs (Fig. 30b). The tubercles on the meri of the walking legs are equal or nearly equal. Similarities between *Paliculus* and *Miropalicus* include a narrow male abdomen, enlarged pterygostomial lobes

Source : MNHN, Paris

each fused to a reduced inner suborbital lobe, simple (not expanded) basal antennal segments, and a similar type of chelipeds, the largest with a thick and high propodus, particularly in males. In fact, ZARENKOV (1968: 765) placed *M. vietnamensis* together with *P. kyusyuensis* (as *Palicus hatusimaensis*) in a group of two Indo-west Pacific palicids related to group 2 of RATHBUN (1918: 184) (see discussion of *Miropalicus*). MOOSA & SERÈNE (1981: 26) provisionally placed these two species in their new genus *Parapalicus* but remarked on the differences between their narrow male abdomens and the broad abdomen of *Parapalicus*. A similar narrow male abdomen is characteristic of *Pseudopalicus* but this genus and *Paliculus* differ widely in the morphologies of the carapace, pereopods, and male first pleopods. There are also marked differences in the morphologies of the carapace and male first pleopods of *Paliculus* and *Parapalicus* (see below).

Besides a small size, *Paliculus* has several characters unique among Indo-west Pacific palicids: a subquadrate carapace with a straight or nearly straight sides and 1-4 pointed (not truncate and short as in *Rectopalicus*) anterolateral teeth on each side, and third maxillipeds where the meri is as wide as the ischia. None of these unique characters appear to be present among described species of palicids from the western Atlantic and eastern Pacific regions. The male first pleopods (Fig. 31e) do not have an helicoidal basal part (in contrast to *Parapalicus*) and the distal part is biramous but much different from any known species of *Pseudopalicus*.

ETYMOLOGY. — From the generic name *Palicus* and the diminutive suffix *-ulus* (Latin).

Key to the species of *PALICULUS*

1. Posterior border of carapace slightly pointed medially (Fig. 32a) ..... ***Paliculus foliatus*** sp. nov.
— Posterior border of carapace slightly convex, not pointed medially **2**

2. Anterolateral border of carapace with two pointed, elongate teeth. Supraorbital border with one median lobe having one pointed tip. Suborbital border with one lobe ..... ***Paliculus kyusyuensis*** (Yokoya, 1933)
— Anterolateral border of the carapace with one pointed, elongate tooth. Supraorbital border with one median lobe having two pointed tips. Suborbital border with two lobes ..... ***Paliculus*** sp.

Paliculus kyusyuensis (Yokoya, 1933)

Figs 30b, 31, 56

Palicus kyusyuensis Yokoya, 1933: 206, 217, fig. 70. — SAKAI, 1976: 595, fig. 325b.
Cymopolia kyusyuensis - SAKAI, 1939: 609, fig. 90b; 1956: 52.
Palicus hatusimaensis Sakai, 1963: 230, fig. 7c; 1965: 185, pl. 89, fig. 3; 1976: 595, pl. 205, fig. 3. — TAKEDA & MIYAKE, 1968: 577, fig. 11; 1972: 87. — ZARENKOV, 1968: 765, fig. 3Д [as *Palicus contractus* in caption]. — TAKEDA, 1973: 55.
Parapalicus hatusimaensis - MOOSA & SERÈNE, 1981: 26.

MATERIAL EXAMINED. — **Madagascar**. *Northwest coast, off Nosy Be. "Vauban"*: dredging 2, 12°38.5'S, 48°16.5'E, 240 m, sand, A. CROSNIER coll., 11.10.1974: 1 ♀ (MNHN-B 26769).

Japan. *Sagami Bay*. 30-50 m, Manazuru Marine Laboratory staff coll., 5.08.1960: 1 ♀ holotype of *Palicus hatusimaensis* Sakai, 1963 3.3 x 4.0 mm (SMF 24697).

Kii Peninsula. "Tansei Maru": stn KT96-6, stn TB-3, off Tanabe, 33°39.06'N, 135°06.82'E, 180-187 m, 12.05.1996: 1 ♀ (CBM-ZC 4955).

Bungo Strait. Sandy bottom, T. KOMAI coll., 11.07.1994: 1 ♀ (CBM-ZC 981).

Kyushu. "Soyo Maru", stn 304, off southern Miyazaki-ken, 241 m, 12.07.1928: 1 juv. ♀ (KMNH).

Tsushima Islands. Stn 33, 34°16'N, 129°31.5'E, 105 m, sand and shells, 5.08.1968: 1 ♀ (ZLKU 13565). — Stn 35, 34°25.1'N, 129°59.3'E, 115 m, coarse sand and shells, 5.08.1968: 1 ♀ (ZLKU 12901). — Stn no. missing: 2 ♂, 2 ♀ (ZLKU 13566).

Source : MNHN, Paris

Amami Islands. "Toyoshio-Maru": stn 8, off Kekaroma Island, 28°04.71'N, 129°27.38'E, sledge net, 310 m, E. TSUSHIDA coll., 10.11.1994: 3 ♀ (CBM-ZC 4951).

Indonesia. *Kai Islands.* SIBOGA EXPEDITION: stn 260, 05°36.5'S, 132°55.2'E, 90 m, sand, coral and shells, 16-18.12.1899: 1 ♂ (ZMUC). — KARUBAR: stn DW 2, 05°47'S, 132°13'E, 209-240 m, 22.10.1991: 2 ♀ (MNHN-B 26770).

Tanimbar Islands. KARUBAR: stn DW 49, 08°00'S, 132°59'E, 210-206 m, 29.10.1991: 2 ♀ (MNHN-B 26771).

Chesterfield Islands. MUSORSTOM 5: stn 301, 22°06.90'S, 159°24.60'E, 487-710 m, 12.10.1986: 1 ♀ 2.8 x 3.2 mm (MNHN-B 26766).

New Caledonia. BIOCAL: stn DW 77, 22°15'S, 167°15'E, 440 m, 5.10.1985: 1 ♂ 2.7 x 3.1 mm, 1 ♀ (MNHN-B 26767); 1 ♀, 1 juv. ♀ 3.5 x 3.6 mm (MNHN-B 26768).

Wallis Island. MUSORSTOM 7: stn DW 610, 13°21'S, 176°09'W, 286 m, 26.05.1992: 1 ♀ (MNHN-B 26772).

TYPES. — *Holotype* of *Palicus kyusyuensis* Yokoya, 1933: 1 ♀, south of Koshiki Islands, Japan, stn 423, 243 m, 15.07.1929 (deposit unknown, possibly lost).

Holotype of *Palicus hatusimaensis* Sakai, 1963: 1 ♀ 3.3 x 4.0 mm, Sagami Bay, Japan (SMF 24697).

TYPE LOCALITY. — South of Koshiki Islands, southwest of Kyushu, Japan, 243 m.

DIAGNOSIS. — Carapace (Figs 30b, 31a; YOKOYA, 1933, fig. 30; SAKAI, 1963, fig. 7c; 1976, pl. 205, fig. 3; SAKAI's references as *Palicus hatusimaensis*) with two narrow, pointed anterolateral teeth (2-3 very small teeth may be present posterior to anterolateral teeth) on each side. Dorsal surface of carapace with small, rounded tubercles (less common in smaller individuals); two raised, granular bosses on metagastric region; four salient tubercles along posterior border. Supraorbital borders each with one short, rounded or pointed, median lobe. Postorbital angle long, pointed outward. Suborbital border (Fig. 31b; ZARENKOV, 1968, fig. 3Д, as *Palicus contractus* in caption; TAKEDA & MIYAKE, 1968, fig. 11a, as *P. hatusimaensis*) each limited by conspicuous, ventrally projecting pterygostomial lobe and broad, rounded outer lobe. One pointed or rounded tooth on each ridge connecting pterygostomial lobe with pterygostomial region of carapace (Fig. 31b); conspicuous, sharp tooth on pterygostomial region anterior to insertion of cheliped. Dorsal and outer borders of cheliped propodi each with 2-3 rounded tubercles (SAKAI, 1963, fig. 7c, as *P. hatusimaensis*). Abdomen of mature males narrow, with all segments free; one complete transverse ridge along segments 1-3 (only along central portion of segment 4). Male first pleopods (Fig. 31e; TAKEDA & MIYAKE, 1968, fig. 11b-c, as *P. hatusimaensis*) with straight basal parts; each distal part with elongate dorsal process topped by toothed structure and much shorter ventral process with rounded tips. Abdomen of mature females with segments 4-6 fused, one transverse ridge along each segment 1-3 and proximal portion of fused segment 4-6; ridges with lobed edges, particularly that along segment 3.

DISCUSSION. — *Palicus kyusyuensis* was described from one female specimen from southern Japan (3.2 x 4.3 mm; YOKOYA, 1933: 206). The holotype, which like other specimens examined by Y. YOKOYA should have been deposited at the Zoological Laboratory, Kyushu University, Fukuoka but eventually transferred to the Kitakyushu Museum of Natural History, Kitakyushu, appears to be lost. The original specimen lacked both chelipeds and had only one P2 and one P5.

P. hatusimaensis Sakai, 1963 was described from one female from central Japan (SAKAI, 1963: 230) (the holotype was erroneously referred to as a male in the measurements given by SAKAI). SAKAI unfortunately failed to compare his new species with *P. kyusyuensis*. The examination of SAKAI's holotype (3.3 x 4.0 mm; SMF 24697) plus additional material from Japan and other Indo-west Pacific locations failed to show that *P. hatusimaensis* is different from *P. kyusyuensis*.

One difference, however, is that while the frontal border of the carapace of both *P. kyusyuensis* and *P. hatusimaensis* was described as being bilobed, each lobe of *P. hatusimaensis* is recessed ventrally and topped by a sharp denticle (SAKAI, 1963, fig. 7c), giving the front a 4-lobe appearance. The morphology of the frontal border was found to vary widely. Of the 20 specimens with complete anterior borders that were examined in this study, 12 agreed with the holotype of *P. hatusimaensis* in having a bilobed border with four separate tips and two had four tips in patterns different from that of *P. hatusimaensis* (two broad, straight lobes each with only one pointed tip on the inner or outer border). One female from Kyushu, southern Japan (3.8 x 4.1 mm; KMNH), one female from the Amami Islands, southern Japan (3.0 x 3.5 mm; CBM-ZC 4951), and one juvenile female from New Caledonia (3.5 x 3.6 mm; MNHN-B 26768) clearly had two lobes each with a pointed tip at the apex identical to

Source : MNHN, Paris

those shown in YOKOYA's figure (YOKOYA, 1933, fig. 70). One female from the Chesterfield Islands (2.8 x 3.2 mm; MNHN-B 26766) had a bilobed front, each lobe triangular but without the pointed tip shown in YOKOYA's figure, and another female from the Tsushima Islands, Japan with a single left lobe and a right lobe with two tips (3.4 x 3.8 mm; ZLKU 13565). Finally, one male from the Tsushima Islands (2.4 x 2.6 mm; ZLKU 13566) had a straight front without lobes.

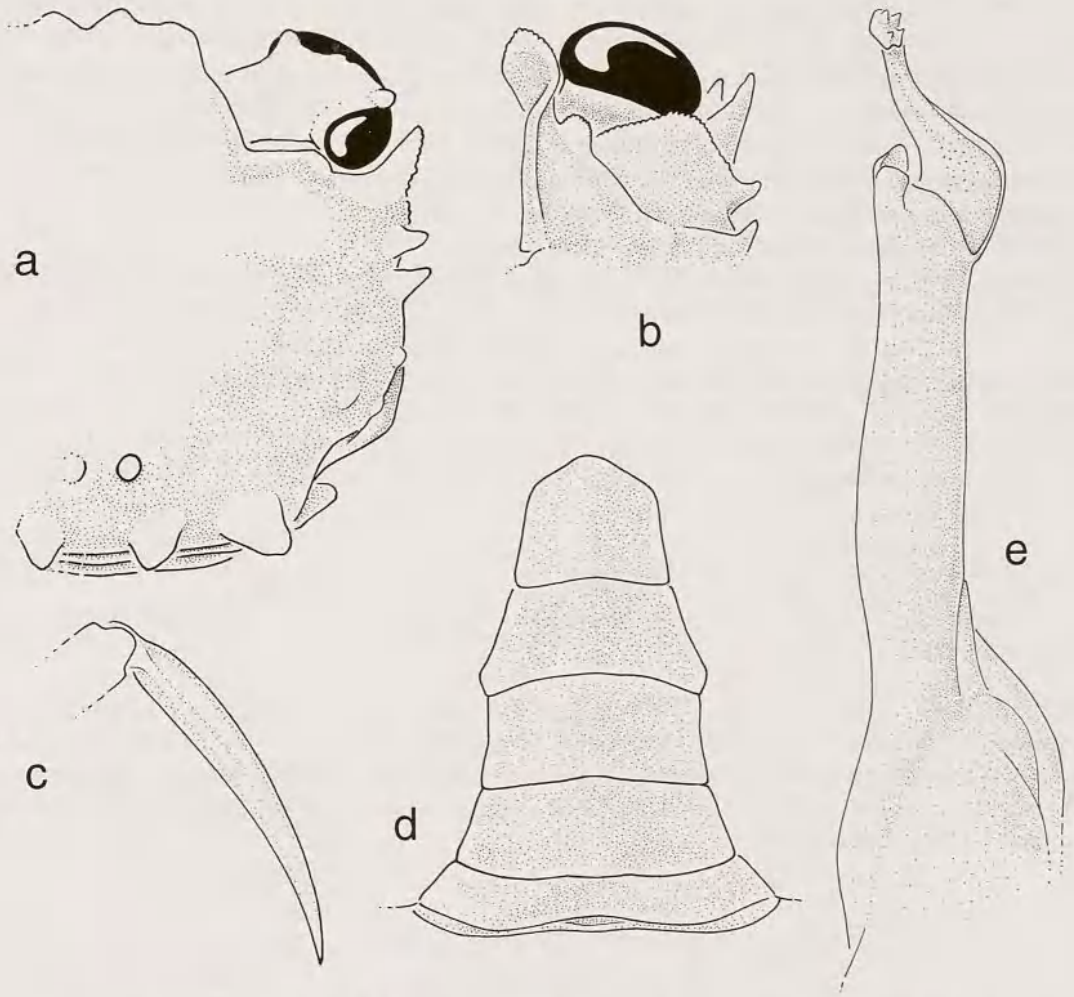


FIG. 31. — *Paliculus kyusyuensis* (Yokoya, 1933), ♂ 2.4 x 2.6 mm, off south coast of New Caledonia, BIOCAL, stn DW 77, 440 m (MNHN-B 26767): **a**, carapace, dorsal view; **b**, suborbital border; **c**, dactylus, right fourth pereopod, dorsal view; **d**, abdomen; **e**, right male first pleopod, ventral view.

There are nevertheless two other differences between YOKOYA's and SAKAI's species. YOKOYA did not mention in his description nor showed in the accompanying figure two characteristics of the species: two raised bosses on the metagastric region of the carapace and four salient tubercles along the posterior border of the carapace. It is assumed that they were overlooked by YOKOYA. His drawings have been known not to be always accurate (see KOMAI, 1996).

SAKAI's description of *P. hatusimaensis* describes "four or five teeth" along each anterolateral border (SAKAI, 1963: 230) but included in this number are the postorbital angle and "two or three tiny teeth" posterior to the two longer anterolateral teeth that are always present. His description therefore should have been five or six but including small teeth posterior to the second anterolateral tooth.

Source : MNHN, Paris

The outer suborbital lobe is shown in a figure given by TAKEDA & MIYAKE (1968, fig. 11a, as *Palicus hatusimaensis*) as a narrow lobe. In all of the specimens that were examined in this study it was broad and rounded like that shown by ZARENKOV (1968, fig. 3Д). Furthermore, TAKEDA & MIYAKE's figure does not show the characteristic pointed teeth on the anterior edge of the ridge that connects the pterygostomial lobe with the pterygostomial region of the carapace. Two teeth are shown in ZARENKOV's figure. Another disagreement between the material examined in this study and TAKEDA & MIYAKE's figures involves the left male first pleopod (TAKEDA & MIYAKE, 1968, figs 11c-d). It was shown as having a single distal part with a "transparent, twisted beak at the tip". The right first pleopod of a male from New Caledonia (2.7 x 3.1 mm; MNHN-B 26767) that is shown in Fig. 31e and those of a male from an unknown location in Japan (2.8 x 3.2 mm; ZLKU 13566) had a biramous distal part that consisted of an elongate dorsal process that ended in a toothed structure and a shorter ventral process with rounded tips. TAKEDA & MIYAKE's specimens were collected in the East China Sea east and southeast of Kyushu, Japan. It was almost identical in size to the New Caledonia and Japan specimens, 2.7 x 3.2 mm. Either these specimens were incorrectly drawn or they may represent a different species .

Even in the absence of YOKOYA's specimen, there is sufficient evidence to consider *Palicus hatusimaensis* Sakai a subjective junior synonym of *Palicus kyusyuensis* Yokoya.

P. kyusyuensis, which is rarely collected due to the small size and fragility of individuals, shows a much wider geographic distribution than originally recorded. It ranges from Madagascar to Japan and Wallis Island in the southwestern Pacific (Fig. 56). It is most probably found across the Indian Ocean.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.4-1.5	2.1-2.2	1.8-1.9	0.9
Merus length/CL	0.5-0.6	0.6-0.7	0.5	0.3
Dactylus length/Cl	0.4	0.5-0.6	0.5	0.2

SIZE. — Maximum size among specimens examined: 3.6 x 4.4 mm (female, CBM-ZC 4955); 2.7 x 3.1 mm (male, MNHN-B 26767).

DISTRIBUTION. — Japan (YOKOYA, 1933; SAKAI, 1963, 1965, 1976; TAKEDA & MIYAKE, 1968, 1972; some records as *P. hatusimaensis*), South China Sea (ZARENKOV, 1968, as *P. hatusimaensis*), and now also known from Madagascar, Sunda and Banda seas (Indonesia), Coral Sea (Chesterfield Islands and New Caledonia), and Wallis Island, southwestern Pacific (Fig. 56). Depth: known reliably between 50 and 487 m; also collected in trawls between 30-50 and 487-710 m.

Paliculus foliatus sp. nov.

Figs 32

MATERIAL EXAMINED. — **New Caledonia**. EXPÉDITION MONTROUZIER: Touho, unknown depth (less than 50 m), 09.1993: 1 ♀ holotype 5.0 x 5.0 mm (MNHN-B 26729).

TYPE. — *Holotype:* 1 ♀ 5.0 x 5.0 mm (MNHN-B 26729).

TYPE LOCALITY. — Touho, northeastern coast of New Caledonia, unknown depth.

DIAGNOSIS. — Carapace (Fig. 32a) subquadrate, with four narrow, pointed anterolateral teeth on each side. Dorsal surface of carapace with small, rounded tubercles; conspicuously depressed area along confluence of branchial and mesogastric regions; two raised, granular bosses on metagastric region; posterior border medially pointed, with four salient tubercles. Supraorbital borders each with one pointed median lobe. Postorbital angle long, pointed outward. Suborbital borders (Fig. 32b) each limited by conspicuous, ventrally projecting pterygostomial lobe and broad, rounded outer lobe. One blunt tooth on each ridge connecting pterygostomial lobe with pterygostomial region of carapace; pointed tooth on pterygostomial region anterior to insertion of cheliped.

Source : MNHN, Paris

Dorsal borders of cheliped propodi each with one conspicuous, rounded tubercle. Borders of meri and carpi of second to fourth walking legs (P2-4; Fig. 32c) with thin, rounded tubercles. Abdomen of mature females with segments 3-5 fused, one transverse ridge along segment 1; ridge with lobed edges. Males unknown.

DESCRIPTION. — Carapace (Fig. 32a) subquadrate, as wide as long (CW/CL = 1.0 in single specimen known); dorsal surface much depressed, with few large granules, two raised, granular bosses on metagastric region. Confluence of branchial and mesogastric regions conspicuously depressed, granular. Anterolateral borders of carapace each with four narrow, pointed anterolateral teeth. Posterior border pointed, with one salient, rounded tubercle at junction with each posterolateral side, two similar but smaller tubercles on median pointed tip.

Frontal border of carapace divided into two narrow, widely separated lobes. Borders between frontal lobes and supraorbital borders slightly folded upward medially, ending in sharp angle forming L- shaped fissure before supraorbital border. Supraorbital borders each with one pointed median lobe. Postorbital angles long (extend beyond dorsal border of retracted eye), pointed outward. Cornea of eyes dorsoventrally flattened, wider than base of long eye peduncle; each peduncle with several conspicuous, elongate, granular tubercles.

Suborbital borders (Fig. 32b) each limited by conspicuous, ventrally inclined, broad pterygostomial lobe on inner edge (inner suborbital lobe reduced, compressed by pterygostomial lobe) and one rounded, short outer lobe. Ridge connecting each pterygostomial lobe with pterygostomial region with blunt tooth. Pointed tooth on pterygostomial region anterior to insertion of cheliped.

Each basal antennal segment slightly expanded outward; three rounded tubercles along expanded margin; flagellum long, with very long, simple setae. Epistome narrow, vertically inclined, with no apparent teeth. Inner border of ischia of third maxillipeds straight; surface granular, upper borders rounded. Meri much narrower than ischia; two large tubercles, broad, serrated upper borders.

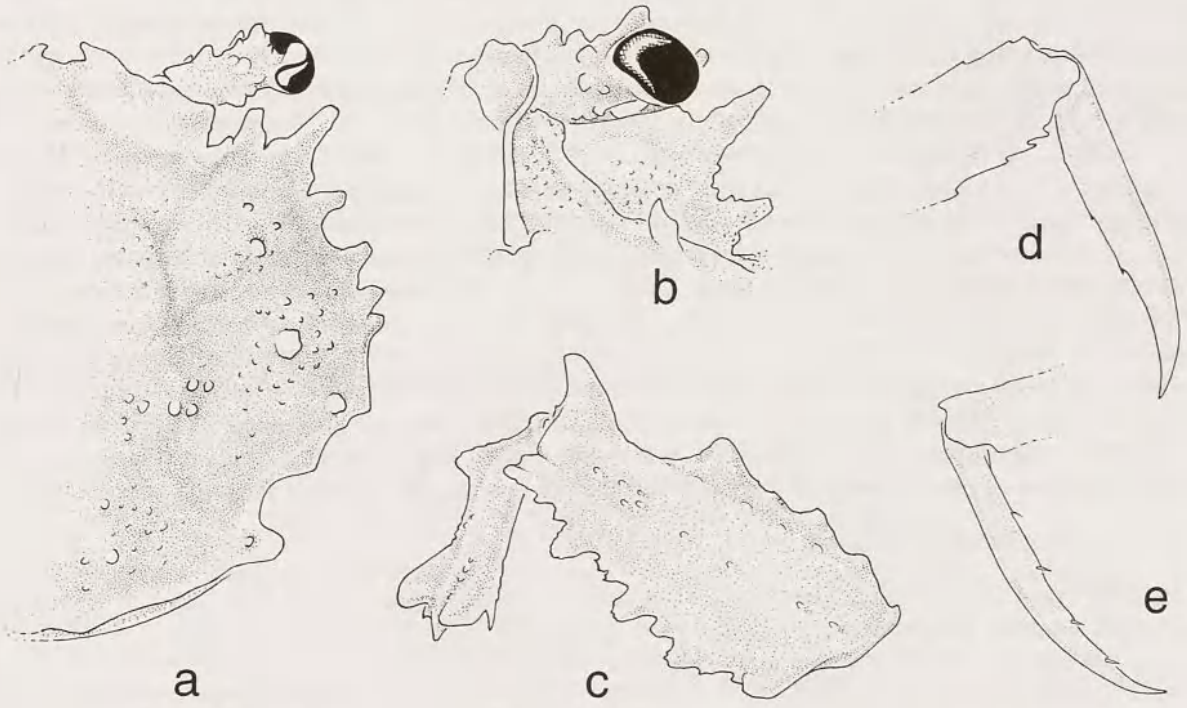


FIG. 32. — *Paliculus foliatus* sp. nov., ♀ holotype 5.0 x 5.0 mm, Touho, northeast coast of New Caledonia, EXPÉDITION MONTROUZIER, unknown depth (MNHN-B 26729): **a**, carapace, dorsal view; **b**, suborbital border; **c**, merus, left third pereopod, dorsal view; **d**, dactylus, right fourth pereopod, dorsal view; **e**, dactylus, left fifth pereopod, dorsal view.

Dorsal and outer borders of propodus of largest cheliped with one conspicuous, rounded, anteriorly inclined tubercle; smallest cheliped with one large, anteriorly inclined tubercle and two smaller, rounded tubercles on

Source : MNHN, Paris

proximal and distal borders. Fingers of both chelipeds with cutting edges. Outer borders of carpi and meri with conspicuous, elongate, rounded tubercles.

Walking legs (P2-4) slender but with flattened, non-filiform propodi. Upper and lower borders of meri (Fig. 32c) with thin, rounded tubercles; distalmost tubercle on each anterior border much wider at base, much higher; similar thin, rounded tubercles on anterior borders of propodi. Anterior and posterior borders of propodi with short teeth (most topped by small spine on posterior border); posterior border of dactyli with 1-2 teeth (Fig. 32d). P3-4 with one dorsal, one ventral carina each (all very slight) on carpi, propodi, and dactyli. Meri of all walking legs with long plumose setae; dorsal surfaces of propodi of P3-4 each with one row of conspicuous plumose setae each along anterior and posterior borders, dactyli with one similar row along anterior borders.

First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair slightly shorter than second. Fifth pair of pereopods (P5) short (0.7 CL); each merus slender, low tubercles along posterior border; each propodus with four low tubercles, three of which topped by short spine; each dactylus (Fig. 32e) with four short, thin spines along posterior border, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.0	1.3	1.2	0.7
Merus length/CL	0.4	0.4	0.4	0.2
Dactylus length/Cl	0.2	0.3	0.3	0.2

Abdomen of mature females with segments 3-5 fused, one transverse ridge with lobed edges along segment 1. Male first pleopods and abdomen of males and immature females unknown.

DISCUSSION. — This species is described from only one small, ovigerous female. Its has a unique, depressed, leaf-like carapace with pointed posterior border and thin, broad tubercles along the borders of the walking legs (P2-P4). It shares more characters with *Paliculus*, specifically with *P. kyusyuensis*, than with any other genus. It shares with *P. kyusyuensis* the morphologies of the supraorbital border (only one median lobe), suborbital border (one broad, short lobe, inner lobe reduced and compressed by pterygostomial lobe), pterygostomial region (blunt tooth on ridge connecting the pterygostomial lobe with the pterygostomial region, pointed tooth on pterygostomial region anterior to insertion of cheliped; Fig. 32b), female abdomen (fusion of some of the segments, lobed transverse ridge), narrow and pointed anterolateral teeth, salient tubercles along posterior border, long and outwardly pointed postorbital angle, and narrow epistome. Yet, there are very strong differences between the walking legs of both species (very long and filiform in *P. kyusyuensis*) and body size (smaller in *P. kyusyuensis*). There are also differences in the basal antennal segments (rectangular without outward expansion in *P. kyusyuensis*) and maxillipeds (much longer exopod and merus, narrower anterior border in *P. kyusyuensis*).

Some of the outstanding differences between the two species may be accounted to different habitats. *P. kyusyuensis* is an inhabitant of soft sediments in moderate depths. The habitat of *P. foliatus* remains unknown but its unique shape and shorter walking legs suggest that it lives cryptically on a hard substrate.

SIZE. — Size of female holotype: 5.0 x 5.0 mm (MNHN-B 26729).

ETYMOLOGY. — From *phyllon*, Greek for leaf, in reference to the leaf-like shape of the sides of the carapace and tubercles along the walking legs.

DISTRIBUTION. — Known only from New Caledonia. Depth: unknown but probably shallow water.

Paliculus sp.

Fig. 33

MATERIAL EXAMINED. — **Philippine Islands**. MUSORSTOM 3: stn DR 117, 12°31'N, 120°39'E, 92-97 m, 3.06.1985: 1 ♀ 2.3 x 2.4 mm (MNHN-B 26730).

Source : MNHN, Paris

FIG. 33. — *Paliculus* sp.: ♀ 2.3 x 2.4 mm, Mindoro Strait, Philippine Islands, MUSORSTOM 3, stn DR 117, 92-97 m (MNHN-B 26730): carapace, dorsal view.

DIAGNOSIS. — Carapace (Fig. 33) subquadrate with one small, pointed anterolateral tooth on each side (4-5 very small pointed tubercles present posterior to anterolateral tooth). Dorsal surface of carapace with scattered, small, rounded tubercles; two slightly raised, granular bosses on metagastric region; four tubercles along posterior border. Supraorbital borders each with one conspicuous, bilobed median lobe. Postorbital angles long and pointed outward. Suborbital border each limited by conspicuous, ventrally projecting pterygostomial lobe and two broad, rounded lobes. One tooth on each ridge connecting pterygostomial lobe with pterygostomial region of carapace. Abdomen of mature females with segments 3-6 fused and one transverse ridge along each segment 1-3 and proximal portion of fused segments 3-6. Males unknown.

DISCUSSION. — One very small, ovigerous female from the Mindoro Strait, Philippine Islands (2.3 x 2.4 mm; MNHN-B 26730) shares many characters with *P. kyusyuensis*. The specimen, however, lacks all appendages.

As in *P. kyusyuensis*, the carapace is subquadrate with few tubercles (less tubercles that are less pronounced than in *P. kyusyuensis*) and one pointed anterolateral tooth on each side (shorter that the two in *P. kyusyuensis*), the postorbital angles are thin, curved, and pointed outward, each supraorbital border has one median lobe (but bilobed and larger than in *P. kyusyuensis*), the suborbital borders are limited by a conspicuous pterygostomial lobe and each has two lobes (only one in *P. kyusyuensis*), there is one tooth on the ridge that connects each pterygostomial lobe with the pterygostomial region of the carapace, and one tooth on the pterygostomial region (all more conspicuous and salient in *P. kyusyuensis*). The episternal processes are narrow, pointed, and smaller than in *P. kyusyuensis*.

Although the species appears to be new, it is not being described as such because of the lack of information on the morphology and relative size of the walking legs. It is placed in *Paliculus* due to its close proximity to *P. kyusyuensis*, at least as far as the morphology of the carapace is concerned.

The only specimen known is the smallest ovigerous female recorded (2.3 x 2.4 mm) for any of the species of palicids that was examined in this study.

DISTRIBUTION. — Known only from the Philippine Islands. Depth: 92-97 m.

Genus ***RECTOPALICUS*** nov.

TYPE SPECIES. — *Rectopalicus woodmasoni* (Alcock, 1900). Gender: masculine.

DIAGNOSIS. — Frontal border of carapace divided into four pointed or two broad lobes. Carapace subquadrate or subpyriform, border posterior to postorbital angle nearly straight; truncate anterolateral teeth. Dorsal surface of carapace with tuberculate bosses or rounded tubercles. Eyes dorsoventrally flattened, wider than peduncle; peduncles with many granular tubercles. Supraorbital borders each with two rectangular or rounded lobes. Suborbital borders each with two short lobes. Each basal antennal segment rectangular, without distal expansion. Epistome vertically inclined or expanded dorsoventrally; two triangular median teeth. Chelipeds nearly equal or unequal in both sexes. First three pairs of walking legs (P2-4) with flattened (not filiform) carpi, propodi, and dactyli. First pair (P2) much shorter than second pair and third pairs (P3-4), third pair as long as second pair. Borders of meri and carpi of P2-4 with nearly equal rounded tubercles; posterior borders of propodi and dactyli with short spines. Fifth pair of pereopods (P5) reduced (0.5-0.8 CL), thick or slender. Abdomen of mature males, elongate (sides almost parallel to

Source : MNHN, Paris

each other), with all segments free, one transverse ridge along each segment 1-4 (may be incomplete in segment 4). Male first pleopods with sinuous basal parts; each distal part uniramous, laterally flattened, dissimilar dorsal and ventral tips that may have teeth. Abdomen of mature females with all segments free, one transverse ridge along each segment 1-4.

DESCRIPTION. — Carapace subquadrate or subpyriform; dorsal surface covered with granules or rounded tubercles, some grouped into bosses. Confluence of branchial and mesogastric regions depressed. Sulcus between hepatic and branchial regions apparent. Anterolateral borders of carapace nearly straight, with short, truncate teeth, or straight along anterior portion and conspicuously rounded posteriorly with short, truncate teeth. Thoracic sternite 7 with much reduced process (episternal process) at each outer edge and posterior to insertion of fifth pair of pereopods (P5), visible dorsally as rounded process.

Frontal border of carapace divided into four pointed or two broad lobes. Supraorbital borders each with two rectangular or rounded lobes. Postorbital angles short or long and pointed. Cornea of eyes dorsoventrally flattened, wider than base of eye peduncle; each peduncle with many granular tubercles. Orbits deep and wide.

Suborbital borders each with short inner and outer lobes. Pterygostomial lobe at each anterolateral angle of buccal frame straight, with broad, rounded or straight border.

Each basal antennal segment thick, rectangular, and covered with tubercles; flagellum short with few long plumose setae. Epistome vertically inclined or broad and expanded dorsoventrally. Border of epistome with two large, triangular median teeth plus two similar outer processes fusing distally with each pterygostomial lobe. Meri of third maxillipeds narrower than ischia.

Chelipeds nearly equal or unequal in both sexes. Fingers slender, with broadly rounded teeth. First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair about same long as second. First three pairs of walking legs (P2-4) with flattened (not filiform) carpi, propodi, and dactyli; anterior (dorsal) and posterior (ventral) borders of meri with nearly equal tubercles; anterior border of carpi with rounded or slightly pointed tubercles; posterior borders of propodi and dactyli with spines or small teeth tipped by a spine. Last two pairs of walking legs (P3-4) each with broad coxae, having flattened, thick edged anterior and posterior borders. Fifth pair of pereopods (P5) reduced (0.5-.08 CL), thick or slender; basis-ischia and meri with small tubercles; spines along posterior border of dactyli.

Abdomen of mature males elongate, with both sides almost parallel to each other, with all segments free, segments 1-2 dorsoventrally compressed, one transverse ridge along each segment 1-3 or 1-4 (incomplete in segment 4). Male first pleopods with sinuous basal parts; each distal part biramous or uniramous, thick, laterally flattened and with dissimilar dorsal and ventral tips; teeth may be present. Second male pleopods short, thin, slightly curved; distal segment with blunt tip.

Abdomen of mature females broad and rounded, with all segments free, segments 1-2 dorsoventrally compressed, one transverse ridge along each segment 1-4. Abdomen of immature females, when known, triangular (but broader than in males), segments 1-2 dorsoventrally compressed, 4-6 fused, transverse ridge along segments 1-4.

SPECIES INCLUDED. — Three species are known: *R. amphiceros* sp. nov., *R. ampullatus* sp. nov., and *R. woodmasoni* (Alcock, 1900).

SEXUAL DIMORPHISM. — Males are smaller than females as in other palicids. Only one specimen of each sex were examined in *R. amphiceros* and *R. ampullatus*; more specimens of *R. woodmasoni* were available for examination but only three were males. The cheliped propodus of the largest cheliped is thicker in the males of *R. amphiceros* and *R. woodmasoni*, while they are only slightly thicker in the male of *R. ampullatus*.

DISCUSSION. — *Rectopalicus* comprises three species that share conspicuously nearly straight lateral borders, short and truncate anterolateral teeth, and spines on the propodi of the walking legs. There are also some similarities in the male first pleopods. Two of the species, *R. amphiceros* and *R. woodmasoni*, are very similar in most characters except in their male first pleopods, clearly uniramous in *R. amphiceros* but seemingly biramous in *R. woodmasoni*. *R. ampullatus*, however, shows differences that are perhaps the result of drastic modifications to its general body plan, its uniquely subpyriform carapace that is straight anteriorly but rounded posteriorly (Figs 36a, 37a). The epistome is broader than that of *R. woodmasoni* (but not so much than in *R. amphiceros*,

Source : MNHN, Paris

which is slightly expanded dorsoventrally and as such it may be considered intermediate between *R. ampullatus* and *R. woodmasoni*), the walking legs (P2-P4) are shorter, last pair of pereopods (P5) more slender and shorter, and the body is covered by rounded tubercles. Its male first pleopods, however, are uniramous and very similar to those of *R. amphiceros*.

There are some similarities between *Rectopalicus* and *Exopalicus* new genus, which has a very different body plan, with a carapace that is conspicuously convex and very short walking legs (Fig. 37d). Both genera share spines along the propodi of the walking legs and (with the exception of *R. woodmasoni*) a uniramous, angular male first pleopod. The similarities between *Exopalicus* and *R. ampullatus*, in particular, are more marked: short walking legs, slender and short P5, and body covered with rounded tubercles. Their respective body plans, however, are unique and very different from each other, in addition to differences in the epistome and third maxillipeds. The collection of additional specimens and perhaps new species may clarify the position of both genera within the Palicidae.

The nearly straight lateral borders and truncate anterolateral teeth of *Rectopalicus* are not shared with any known species of western Atlantic or eastern Pacific palicids.

ETYMOLOGY. — From *rectus*, Latin for straight, and the generic name *Palicus*, in reference to the diagnostic, nearly straight lateral borders of the carapace.

Key to the species of *RECTOPALICUS*

1. Carapace with anterolateral borders straight anteriorly but rounded posteriorly (Figs 36a, 37a). Abdomen of males and females covered with low, rounded tubercles (Fig. 36e) ..... ***Rectopalicus ampullatus*** sp. nov.
— Carapace with nearly straight lateral borders. Abdomen of males and females not covered by conspicuous tubercles **2**

2. Postorbital angles conspicuously pointed outward (Figs 35a-b). Spines but no teeth along the posterior border of dactyli of walking legs (P2-4; Fig. 35c). Male first pleopods uniramous (Figs 35d-e) ..... ***Rectopalicus amphiceros*** sp. nov.
— Postorbital angles not conspicuously pointed outward (Figs 8c, 37c). Teeth (which may be topped by a spine) along posterior border of dactyli of walking legs (P2-4). Male first pleopods with two lobes (Figs 34a-b) ..... ***Rectopalicus woodmasoni*** (Alcock, 1900)

Rectopalicus woodmasoni (Alcock, 1900)

Figs 8c, 34, 37c, 53

Palicus Wood-Masoni Alcock, 1900: 795. — ALCOCK & MCARDLE, 1903: pl. 67, fig. 3.
Palicus microfrons Sakai, 1963: 228, fig. 7b; 1965: 184, pl. 89, fig. 2; 1976: 594, fig. 325a, pl. 205, fig. 4.
Pseudopalicus woodmasoni - MOOSA & SERÈNE, 1981: 35 (in key).
Palicoides microfrons - TAKEDA, 1982b: 17, fig. 2.

MATERIAL EXAMINED. — **Japan**. *Kii Peninsula.* Shionomisaki, 33°26.13'N, 135°40.64'E, 160 m, S. NAGAI coll., 16.01.1997: 1 ♀ (CBM-ZC 3603); 100 m, S. YAMAGUCHI coll., 22.09.1978: 2 ♀ (CBM-ZC 4262).

Ryukyu Islands. "Toyoshio-Maru": stn 8, Amami Islands, off Kekaroma Island, 28°04.71'N, 129°27.38'E, 310 m, K. TSUSHIDA coll., , 10.11.1994: 1 juv. ♀ (CBM-ZC 4951).

Philippine Islands. MUSORSTOM 1: stn 57, 13°53.1'N, 120°13.2'E, 107-96 m, 26.03.1976: 1 ♀ (MNHN-B 26778).

Thailand *(Andaman Sea coast)*. Stn H38/D, off Phuket island, 9.05.1996: 1 ♂ CL 5.1 mm (PMBC).

Indonesia. *Kai Islands.* KARUBAR: stn DW 22, 05°22'S, 133°01'E, 124-85 m, 25.10.1991: 1 ♀ (MNHN-B 26773).

New Caledonia. *"Kandjar"*, dredgings between 22°40'-22°50'S and 167°10'-167°30'E, 200-350 m, P. TIRARD coll., 7-10.10.1986: 1 ♀ (MNHN-B 26780).

SMIB 5: stn DW 95, 22°59.7'S, 168°19.8'E, 200 m, 14.09.1989: 1 juv. ♂ 5.4 x 5.7 mm (MNHN-B 26775).

Source : MNHN, Paris

BATHUS 2: stn DW 723, 22°50.21'S, 167°26.84'E, 430-433 m, 11.05.1993: 1 ♂ 7.2 x 7.6 mm (MNHN-B 26777). — Stn DW 728, 22°47.11'S, 167°28.11'E, 241-245 m, 12.05.1993: 1 ♀ 9.4 x 10.3 mm (MNHN-B 26774), 1 ♀ (MNHN-B 26781).

BATHUS 3: stn DW 836, 23°02'S, 166°59'E, 295-306 m, rocks and gravel, 30.11.1993: 1 juv. ♂ 5.5 x 5.6 mm, 1 ♀ (MNHN-B 26776).

Vanuatu. MUSORSTOM 8: stn CP 1131, 15°38.41'S, 167°03.52'E, 140-175 m, 11.10.1994: 1 juv. ♀ (MNHN-B 26779).

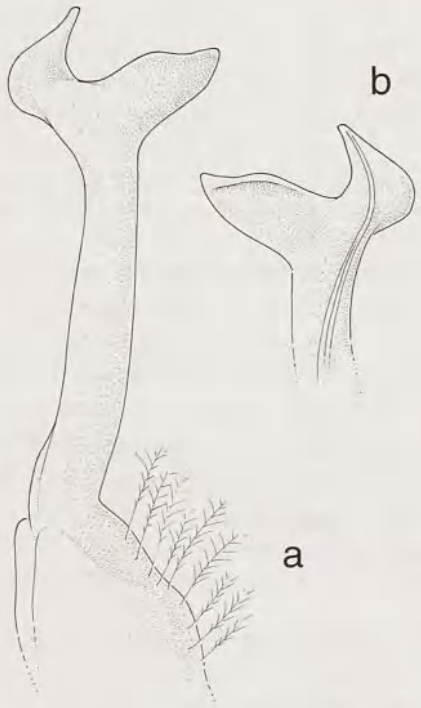


FIG. 34. — *Rectopalicus woodmasoni* (Alcock, 1900), ♂ 7.2 x 7.6 mm, off south coast of New Caledonia, BATHUS 2, stn DW 723, 430-433 m (MNHN-B 26777): **a**, left male first pleopod, ventral view; **b**, left male first pleopod, distal part, dorsal view.

TYPES. — *Holotype* of *Palicus woodmasoni* Alcock, 1900: 1 ♂ 9 x 11 mm (ALCOCK, 1900), Andaman Islands. Deposit unknown: Zoological Survey of India, Calcutta ?

Holotype of *Palicus microfrons* Sakai, 1963: 1 ♀ 8.0 x 9 mm (SAKAI, 1963), Misaki, Sagami Bay, Japan, 85 m, EMPEROR OF JAPAN coll. (Showa Memorial Institute, National Science Museum, Tsukuba).

TYPE LOCALITY. — Andaman Islands, India.

DIAGNOSIS. — Carapace (Figs 8c, 37c; ALCOCK & MCARDLE, 1903, pl. 67, fig. 3; SAKAI, 1963, fig. 7b; 1976, fig. 325a, pl. 205, fig. 4) subquadrate, typically with four truncate anterolateral teeth on each side; teeth decrease posteriorly in size. Dorsal surface of carapace covered by large granules and several granular bosses; posterior border with six elongate tubercles (continuous in small specimens). Supraorbital borders each with two rounded lobes, outer lobe slightly narrower than inner lobe. Suborbital border obliquely directed, with rectangular inner lobe and broad, proximally rounded outer lobe. Dorsal borders of cheliped propodi with several rounded or elongate tubercles. Dactyli of walking legs (P2-4) with small teeth along posterior border (2-3 in P4; Fig. 8c). Abdomen of mature males with all segments free, one complete transverse ridge along each segment 1-4 (ridge along segment 4 may be incomplete). Male first pleopods (Figs 34a-b; TAKEDA, 1982b, fig. 2A) with straight basal parts; each distal part with two lateral processes, inner one narrower. Abdomen of mature females with all segments free and one complete transverse ridge along each segment 1-4 (low ridge may be present along segment 5).

DISCUSSION. — *R. woodmasoni* was described as *Palicus woodmasoni* from a single male specimen collected in the Andaman Islands (ALCOCK, 1900). It is not know if the holotype is still extant. The description and excellent figure (ALCOCK & MCARDLE, 1903, pl. 67, fig. 3; reproduced here as Fig. 8c) plus additional material from the western Pacific Ocean and the Andaman Sea not far from the type locality, however, permit its characterization as a species of *Rectopalicus*.

Diagnostic characters other than those given in the diagnosis are a border between the anterior lobes and each supraorbital margin that is folded upward and slightly pointed anteriorly. Each basal antennal segment is rectangular but thick and slightly expanded along the outer border, and a row of low, rounded tubercles along its ventral surface. Each eye peduncle has a conspicuous, triangular tubercle on its anterior border, and a much lower tubercle at the outer end of the tubercle. The pterygostomial lobes project ventrally, forming a flat, triangular structure posterior to each inner suborbital lobe. The epistome is vertically inclined, with two short, slightly pointed median teeth flanked on each side by a large triangular outer process and a thin, rounded margin before each pterygostomial lobe. The third pair of walking legs (P4; Fig. 37c) has short meri (0.4 CL), each armed with one row of a few, elongate teeth along the upper border and one broad and slightly pointed distal tooth. Each dactylus is slender (0.3 CL) and its posterior border is armed with 2-3 small spines or teeth (see below). The fifth pair of

Source : MNHN, Paris

pereopods (P5) is thick and short (0.7 CL). The meri are slender and tuberculate, with conspicuous, rounded and triangular tubercles (small specimens have larger tubercles, each with a short spine), plus a few short spines and plumose setae along the posterior border; each propodus with tubercles and 4-7 spines; each dactylus with 1-2 thick spines along posterior border, microscopic teeth, 1-2 short distal spines along anterior border, and one terminal pointed tooth.

Two female specimens (MNHN-B 26774, Fig. 37c; MNHN-B 26773) had a frontal border with only three lobes, the median one being entire without a sulcus.

Palicus microfrons Sakai, 1963, which was described from one female from Japan, has a subquadrate carapace with straight lateral borders and truncate anterolateral teeth as in *R. woodmasoni*. SAKAI (1963: 230) mentioned that his new species was "closely related" to *Palicus woodmasoni* but that they differed in the "shape and arrangement of the frontal and lateral teeth " and of "features of the granules and tubercles of the dorsal surface of the carapace". These differences were most certainly based only on the examination of ALCOCK's description and figure (ALCOCK & MCARDLE, 1903, pl. 67, fig. 3; reproduced as Fig. 8c) and not by the examination of the holotype that is presumably in Calcutta. ALCOCK mentioned that there were three anterolateral teeth in his species. The figures of SAKAI (1963, fig. 7b; 1976, fig. 325a, pl. 205, fig. 4), however, show four teeth, while those of TAKEDA (1982b, figs 2B-C, as *Palicoides microfrons*) show five.

All specimens examined in this study had four anterolateral teeth. Tubercles along the edge beyond the last tooth may be easily interpreted as small teeth. In a female specimen from Japan (CBM-ZC 4226) one such tubercle appeared on the right side but none on the left. In small specimens the separation between the teeth becomes less well defined. The number of teeth along the anterolateral borders of palicids has always been a matter of interpretation since the postorbital angles are considered as teeth by some and small, tubercle-like teeth may not.

The anterolateral borders of the carapace of *P. microfrons* carapace were described by SAKAI (1963, 228, fig. 7b; 1976, pl. 205, fig. 4) as being "almost straight and slightly divergent backwards". All specimens examined during this study (which included four from Japan) had carapaces that were straight but clearly divergent on a posterior direction, as noticed by TAKEDA (1982b, figs 2B-C, as *Palicoides microfrons*) and shown in a figure by SAKAI (1976, fig. 325a).

The only significant difference between *P. woodmasoni* and *P. microfrons* is in the fact that no mention was made in ALCOCK's description of *P. woodmasoni* of the presence of spines or teeth on the dactyli of the walking legs. Small teeth were shown in his figure (ALCOCK & MCARDLE, 1903, pl. 67, fig. 3; reproduced as Fig. 8c). SAKAI (1963: 230) described "minute spinules" on the dactyli of *P. microfrons*, as shown in his first figures (SAKAI, 1963, fig. 7b; 1976, pl. 205, fig. 4), but were absent in another (SAKAI, 1976, fig. 325a). Either the presence of small spines in the holotype was overlooked by ALCOCK or the dactyli actually had no spines, a situation that has been observed in at least some of the legs of some of the specimens that were examined.

The presence of spines or teeth (if any) on the dactyli of the walking legs is a variable character. Most specimens examined in this study had either teeth or spines. The larger specimens tend to have teeth and the smaller spines but this varies. For example, the largest specimen examined, a female from Japan (9.7 x 10.3 mm; CBM-ZC 4262), had spines on the dactyli of P2-4 of the right side and P2 on the left side but no spines or teeth on the P3-4 of the left side (only half of the dactylus of P4 remained); a smaller female from the same locality (8.6 x 9.1 mm; CBM-ZC 4262) with four walking legs had smooth dactyli in three legs but a spine on the P2; a small female from Japan (6.7 x 7.5 mm; CBM-ZC 3603) with three legs had teeth topped by a spine on a P2, a very short tooth on a P3, and a short tooth topped by a spine on a P4; a large female from New Caledonia (9.4 x 10.3 mm; MNHN-B 26774) had teeth topped by spines, lacking a spine, or only single spines in the four legs that remained.

Only one specimen from the Andaman Sea near the type locality was examined. Although the male specimen (CL 5.1 mm; PMBC) was incomplete, the dorsal surface of the carapace, suborbital region, and abdomen agree with the Japanese and western Pacific specimens that were examined in this study. The legs and first pleopods, which would have provided the key pieces of evidence for the probable separation between the two species, were unfortunately missing.

MOOSA & SERÈNE (1981: 35) did not examine any specimens but included *Palicus woodmasoni* in their new genus, *Pseudopalicus*, but strangely enough without mentioning *Palicus microfrons*. No mention of their syn-

Source : MNHN, Paris

onymy was made, however. There is nevertheless enough evidence to consider *Palicus microfrons* Sakai a junior subjective synonym of *Palicus woodmasoni* Alcock, now included in the new genus *Rectopalicus*.

There are also close similarities between *R. woodmasoni* and *R. amphiceros* sp. nov., a species being described from only two specimens from New Caledonia. *R. amphiceros*, however, has postorbital angles that are conspicuously pointed outward and there are no teeth on the dactyli of the walking legs, among other characters (see description of *R. amphiceros* below).

TAKEDA (1982b) placed *Palicus microfrons* Sakai in *Palicoides* Moosa & Serène, 1981 based on the presence of a "subterminal process" on the male first pleopods. Indeed, the subquadrate shape of the carapace, the presence of truncate anterolateral teeth, and the relatively thicker P5 of *R. woodmasoni* are characteristics of *Palicoides*. The two lateral processes of the pleopods (Figs 34a-b; TAKEDA, 1982b, fig. 2A) nevertheless do not bear a close resemblance to those of *Palicoides longimanus* (Miyake, 1936) (Fig. 43a) or of *P. whitei* (Miers, 1884) (Figs 43b-d), the later characterized by a very conspicuous, arched, and spinous process. The pleopod illustrated by TAKEDA had a longer inner process than that illustrated here (Fig. 43a) and the process showed a row of setae. The difference in the size of both specimens is small (Japanese specimen of TAKEDA: 6.2 x 6.5 mm; specimen illustrated in Figs 34a-b: 7.2 x 7.6 mm, MNHN-B 26777) but it may explain the differences observed. The male first pleopods of two juvenile males (5.4 x 5.7 mm, MNHN-B 26775; 5.5 x 5.6 mm, MNHN-B 26776) were very thin and unspecialized into any defined structures. The male first pleopods of *R. woodmasoni* are somewhat closer to those of *R. amphiceros* sp. nov. (Figs 35d-e), and *R. ampullatus* sp. nov. (Figs 36f-g) in their general shapes.

In addition to the differences in the male first pleopods, other characters support the placement of *Palicus microfrons* in *Rectopalicus*, not in *Palicoides*: 1) four lobes (inner pair rounded, narrow, and short; outer pair very broad, rounded, and typically as high as first pair) on anterior border (only two in *Palicoides*), 2) segments 2-3 of the antennae are relatively narrow and there are conspicuous setae on the flagellum (segments 2-3 very wide and provided with long setae, few setae on flagellum in *Palicoides*), 3) cornea of eyes is dorsoventrally flattened, clearly wider than peduncle, and there is one large distal tubercle on each peduncle (spherical, almost as wide as peduncle and conspicuous crescent-shaped process on peduncle in *Palicoides*), 4) each supraorbital border has two lobes (only one lobe in *Palicoides*), 5) presence of four anterolateral teeth on each side of the carapace (only two in *Palicoides*), 6) chelipeds are relatively short (much longer and slender in *Palicoides*), 7) meri of walking legs (P2-4) have conspicuous tubercles on the upper and lower borders (microscopic tubercles in *Palicoides*), 8) abdomen of mature females has all segments free (segments 5-6 fused in *Palicoides*), and 9) epistome with median teeth and outer process (smooth in *Palicoides*).

SIZE. — Maximum size among specimens examined: 9.7 x 10.3 mm (female, CBM-ZC 4262); 7.2 x 7.6 mm (male, MNHN-B 26777).

DISTRIBUTION. — Andaman Islands (ALCOCK, 1900) and Japan (SAKAI, 1963, 1976; TAKEDA, 1982b; as *P. microfrons*) and now recorded from the Andaman Sea coast of Thailand, Banda Sea (Indonesia), and Coral Sea (Vanuatu and New Caledonia) (Fig. 53). Depth: known reliably between 107 and 430 m; also collected in a trawl between 85 and 124 m.

Rectopalicus amphiceros sp. nov.

Figs 35

MATERIAL EXAMINED. — **New Caledonia**. MUSORSTOM 4: stn DW 203, 22°35.8'S, 167°04.8'E, 105-110 m, 27.09.1985: 1 ♂ holotype 4.6 x 4.8 mm (MNHN-B 26731). — Stn DW 204, 22°37.0'S, 167°05.7'E, 120 m, 27.09.1985: 1 juv. ♀ paratype 4.1 x 4.5 mm (MNHN-B 26732).

TYPES. — *Holotype*: 1 ♂ 4.6 x 4.8 mm, MUSORSTOM 4, stn DW 203 (MNHN-B 26731).
Paratype: 1 juv. ♀ 4.1 x 4.5 mm, MUSORSTOM 4, stn DW 204 (MNHN-B 26732).

TYPE LOCALITY. — Off south coast of New Caledonia, 22°35.8'S, 167°04.8'E, 105-110 m.

Source : MNHN, Paris

DIAGNOSIS. — Carapace (Fig. 35a) subquadrate, with four short, rounded anterolateral teeth on each nearly straight side; teeth slightly decrease posteriorly in size. Dorsal surface of carapace with large granules and several granular bosses; posterior border with four very elongate tubercles. Supraorbital borders each with two rounded lobes. Postorbital angles very long, narrow, pointed outward so they extend only to about half of dorsal border of retracted eye. Suborbital borders (Fig. 35b) obliquely directed, each with rectangular inner lobe and broad, proximally rounded, outer lobe. Dorsal borders of cheliped propodi with several rounded or elongate tubercles. Dactyli of walking legs (P2-4) with thick spines along posterior border (two spines on P4; Fig. 35c). Abdomen of males with all segments free and one complete transverse ridge along each segment 1-3, incomplete ridge along segment 4. Male first pleopods (Figs 35d-e) with straight basal parts armed with teeth and one dorsal tubercle; each distal part with two broad lateral processes, inner one narrower. Abdomen of mature females unknown.

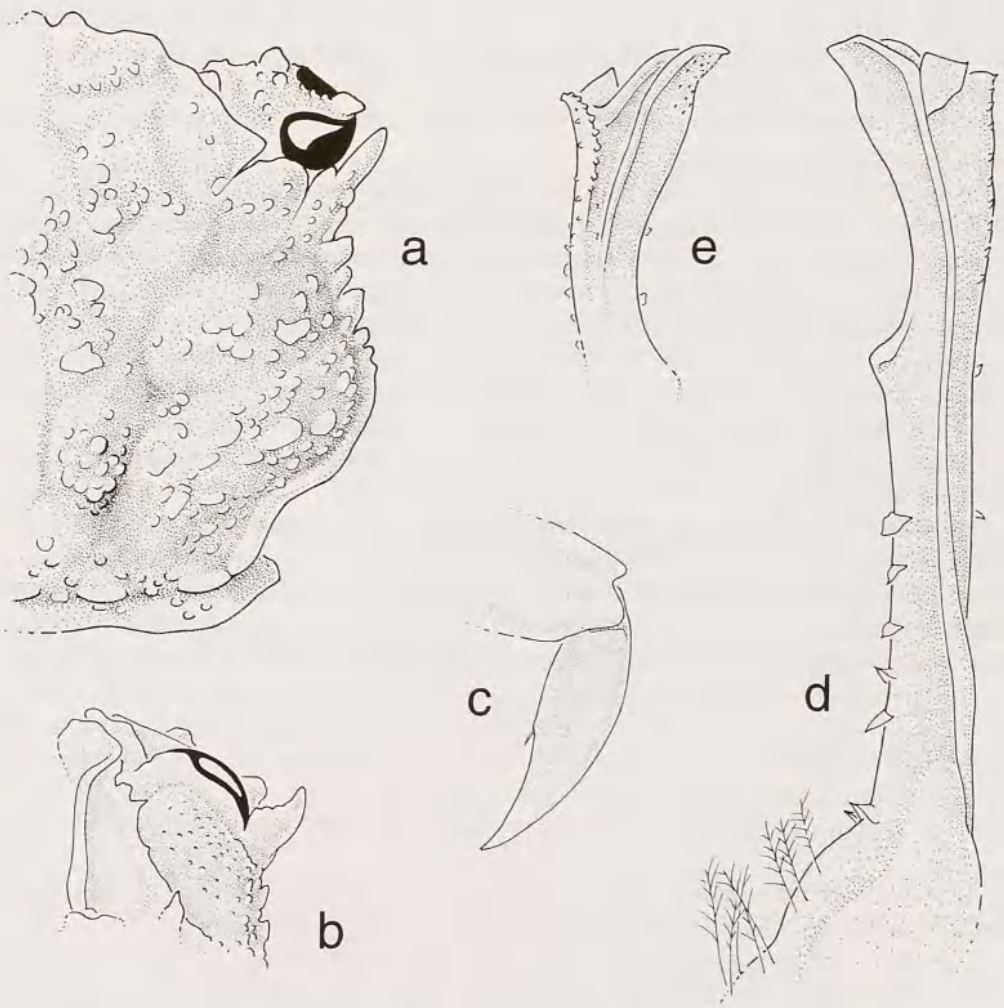


FIG. 35. — *Rectopalicus amphiceros* sp. nov., ♂ holotype 4.6 x 4.8 mm, off south coast of New Caledonia, MUSORSTOM 4, stn DW 203, 105-110 m (MNHN-B 26731): **a**, carapace, dorsal view; **b**, suborbital border; **c**, dactylus, right fourth pereopod, dorsal view; **d**, left male first pleopod, lateral (inner side) view; **e**, left male first pleopod, distal part, lateral (outer side) view.

DESCRIPTION. — Carapace (Fig. 35a) subquadrate, only slightly wider than long (CW/CL = 1.0); dorsal surface of covered by large granules and several granular bosses (several small, rounded bosses on branchial and gastric regions, one row across lower third of carapace). Anterolateral borders of carapace nearly straight, each with four

Source : MNHN, Paris

short, rounded teeth decreasing posteriorly in size. Posterior border with four elongate tubercles and scattered plumose setae.

Frontal border of carapace divided into four lobes, inner pair rounded, narrow and short, outer pair very broad, rounded, shorter than first pair. Borders between frontal lobes and supraorbital borders folded upward, with almost straight margin ending in sharp angle forming V-shaped fissure before supraorbital border. Supraorbital borders each with two rounded lobes, outer lobe slightly narrower than inner lobe. Postorbital angles long, slender, and pointed outward, so they only extend to about half of dorsal border of retracted eye. Cornea of eyes dorsoventrally flattened, wider than base of eye peduncle; each peduncle with one large distal tubercle.

Suborbital borders (Fig. 35b) obliquely directed, each with rectangular inner lobe, broad, proximally rounded, outer lobe. Pterygostomial lobes short, straight, with rounded borders. Ridge connecting each pterygostomial lobe with pterygostomial region with row of pointed teeth. Pointed tooth on pterygostomial regions anterior to insertion of chelipeds.

Each basal antennal segment slender and rectangular (row of rounded tubercles along ventral surface); flagellum long, with very few, simple setae. Epistome slightly expanded dorsoventrally, with two triangular median teeth, each flanked by triangular, narrow, pointed outer process and thin, rounded margin before pterygostomial lobe. Inner border of ischia of third maxillipeds straight; surface granular, upper borders rounded to slightly pointed. Meri narrower than ischia; oblong upper borders.

Dorsal borders of cheliped propodi each with 3-4 rows of rounded and pointed tubercles. Fingers with 3-4 broadly rounded teeth. Carpi short, outer border with pointed tubercles; meri slender, with rounded tubercles.

First three pairs of walking legs (P2-4) of holotype slender but flattened. Upper and lower borders of meri with rounded, proximal tubercles; distalmost tubercle on each anterior border much wider at base, much higher, slender, pointed or rounded, directed distally. Carpi of walking legs (P2-4) elongate; posterior borders of propodi and dactyli with small spines (Fig. 35c). Each P2 with one dorsal carina, 2-4 spines along posterior border of propodus; one minute spine along posterior border of dactylus. P3-4 each with one dorsal, one ventral carina on carpus, propodus, and dactylus; 1-3 spines along posterior border of propodus. Meri of all walking legs with scattered plumose setae; dorsal surfaces of propodi and dactyli of P3-4 each with one row of conspicuous plumose setae along anterior and posterior borders.

First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); fourth pair slightly longer than third. Fifth pair of pereopods (P5) short (0.8 CL); each merus very slender, with plumose setae along posterior border; each propodus and dactylus with many long simple and plumose setae along both borders; each dactylus with one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.0	1.3	1.4	0.8
Merus length/CL	0.3	0.4	0.4	0.3
Dactylus length/Cl	0.3	0.3	0.3	0.2

Abdomen of males with all segments free. One complete transverse ridge along each segment 1-3 (low, incomplete ridge along most of segment 4). Male first pleopods (Figs 35d-e) with sinuous basal parts, borders with teeth and one tubercle on each dorsal side; each distal part laterally flattened, with one pointed dorsal edge and one straight ventral edge bordered by minute teeth. Abdomen of mature females unknown.

DISCUSSION. — *P. amphiceros* is described from only one complete specimen, the male holotype. The paratype, a juvenile female, had only two walking legs. Notwithstanding the scarcity of material and its very close proximity to *R. woodmasoni*, it is described as a separate species on account of the unique male first pleopods and the outward orientation of its postorbital angles. It can be separated from *R. woodmasoni* by these two characters and the presence of shorter and slightly rounded anterolateral teeth (conspicuously truncate in *R. woodmasoni*), four tubercles along the posterior border of the carapace (six in *R. woodmasoni*), and by having spines along the posterior border of the dactyli of the walking legs (teeth that may be topped with spines in *R. woodmasoni*). Some of these characters, however, may be present only in small specimens, the only type of specimens thus far known.

Source : MNHN, Paris

The unique male first pleopods are laterally flattened like those of *R. ampullatus* but they are much more complex. Each basal part has thick teeth and one large dorsal tubercle vary similar to that of *Pseudopalicus undulatus* (Figs 14d-e). There are also similarities in their general shape with the male first pleopods of *Exopalicus maculatus* (Edmondson, 1930) (Fig. 38d). It lacks, however, the large lateral teeth of *E. maculatus*.

SIZE. — Size of the only two specimens known to exist: 4.1 x 4.5 mm (female paratype, MNHN-B 26732); 4.6 x 4.8 mm (male holotype, MNHN-B 26731).

ETYMOLOGY. — From the Latinized word for *amphikeros*, Greek for having two horns, in reference to the characteristic postorbital angles, which are pointed in an outward direction as in the horns of cattle.

DISTRIBUTION. — Known only from the Coral Sea (New Caledonia). Depth: 110-120 m.

Rectopalicus ampullatus sp. nov.

Figs 36, 37a-b, 61a

MATERIAL EXAMINED. — **Loyalty Islands**. MUSORSTOM 6: stn DW 462, 21°05.10'S, 167°26.85'E, 200 m, 21.02.1989: 1 ♂ holotype 6.2 x 6.3 mm (MNHN-B 26782).
Futuna Island. MUSORSTOM 7: stn DW 513, 14°13'S, 178°11'W, 260-300 m, 12.05.1992: 1 ♀ paratype 7.9 x 8.7 mm (MNHN-B 26783).

TYPES. — *Holotype*: 1 ♂ 6.2 x 6.3 mm, MUSORSTOM 6, stn DW 462 (MNHN-B 26782).
Paratype: 1 ♀ 7.9 x 8.7 mm, MUSORSTOM 7, stn DW 513 (MNHN-B 26783).

TYPE LOCALITY. — Loyalty Islands, 21°05.10'S, 167°26.85'E, 200 m.

DIAGNOSIS. — Carapace (Figs 36a, 37a, 61a) subpyriform, with anterolateral borders anteriorly straight, posteriorly rounded; rounded portion with four short, truncate teeth on each side. Dorsal surface of carapace with many rounded tubercles and tuberculate bosses. Supraorbital borders each with two very short lobes. Suborbital borders (Fig. 36c) each with short, irregular inner and outer lobes. Dorsal borders of cheliped propodi with rounded tubercles. Dactyli of walking legs (P2-4) with teeth along posterior border (two teeth in P4; Fig. 36d). Abdomen of males (Fig. 36e) with all segments free, one complete transverse ridge along each segment 1-3 (incomplete ridge along each median portion of segment 4). Male first pleopods (Figs 36f-g) with sinuous basal parts; each distal part laterally flattened with irregular dorsal tip. Abdomen of mature females with all segments free, one complete transverse ridge along each segment 1-4 (low ridge along segment 5).

Color: The carapace of the live holotype, a male (Fig. 61a), was yellow-brown with a few symmetric, white streaks. The meri and carpi of the second and third walking legs (P3-4) were of the same color, the remaining portions white. A red-brown band crossed the propodi of the second walking legs (P2).

DESCRIPTION. — Carapace (Figs 36a, 37a, 61a) subpyriform, only slightly wider than long (CW/CL = 1.0-1.1); dorsal surface covered with many rounded tubercles and tuberculate bosses, most conspicuous of which are on branchial and metagastric regions. Carapace straight along anterior portion, broad posteriorly; broad portion with four short, truncate teeth on each side (teeth, particularly first two, may be divided into separate teeth or tubercles). Episternal processes reduced (short), granular, rounded. Posterior border with many rounded tubercles, no setae.

Frontal border of carapace divided into two broadly rounded, short lobes. Borders between frontal lobes and supraorbital borders as three successive curved or straight, slightly folded-upward portions separated from each other by pointed tips (first two pointed tips together with pointed lobes gives carapace a four-lobed appearance). Supraorbital borders each with two very short, straight lobes. Postorbital angles short (not extending to dorsal border of retracted eye) with slightly pointed tips. Cornea of eyes dorsoventrally flattened, wider than base of eye peduncle; each peduncle with many granular tubercles (most dorsal, distal tubercles the two most conspicuous).

Anterior portion of body between frontal lobes of carapace and posterior border of meri of third maxillipeds (Figs 36b, 37b) nearly flat; epistome, pterygostomial lobe, and suborbital border fused together. Suborbital borders

Source : MNHN, Paris

(Fig. 36c) each with short inner and outer lobes, both with irregular, tuberculate borders. Pterygostomial lobe at each anterolateral angle of buccal frame short, straight, with rectangular anterior border (broad, flat, irregular border when seen anteriorly).

Each basal antennal segment thick, rectangular, covered with thick tubercles; flagellum short with few long plumose setae. Epistome broad, expanded dorsoventrally, straight except concavity along median portion. Border of epistome with two large, triangular median teeth plus two similar outer processes fusing distally with each pterygostomial lobe. Inner border of ischia of third maxillipeds broadly triangular; surface with rounded tubercles, upper borders straight with oblong tip. Meri as wide as ischia; straight-edged, triangular upper borders.

Chelipeds nearly equal in both sexes. Dorsal and outer borders of cheliped propodi with rows of small, rounded tubercles. Fingers with very short, rounded teeth. Carpi short, outer borders with low, rounded tubercles; meri slender, outer borders with low, rounded tubercles.

First three pairs of walking legs (P2-4; Figs 37a-b) slender but flattened. Anterior (dorsal) and posterior (ventral) borders and dorsal and ventral surfaces of meri with nearly equal, rounded tubercles. Anterior borders of carpi with rounded tubercles; posterior borders of propodi with minute, pointed tubercles, spines on P2. Posterior borders of dactyli with teeth capped with a spine. Each P2 with one dorsal, one ventral row of tubercles on carpus; one dorsal carina, two ventral rows of tubercles, 2-3 short spines on propodus; one dorsal, one ventral carinae, 2-3 teeth on posterior border of dactylus. Each P3 with one ventral row of tubercles on carpus; one dorsal row of tubercles, one carina, two ventral rows of tubercles on propodus; one dorsal, one ventral carinae, 2-3 teeth on posterior border of dactylus. Each P4 with two dorsal, one ventral rows of tubercles on carpus; one dorsal, two ventral carinae on propodus; one dorsal, one ventral carinae, two teeth on posterior border of dactylus (Fig. 36d). Meri of all walking legs with very few, scattered plumose setae; dorsal surfaces of propodi and dactyli of P3-4 with one row of conspicuous plumose setae along anterior and posterior borders (setae along posterior borders of dactyli particularly longer).

First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair about same size as second. Fifth pair of pereopods (P5) very short (0.5 CL); each merus slender, tuberculate surface; each propodus with low tubercles; each dactylus with three short, thin spines along posterior border, one terminal pointed tooth.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	0.7	1.0-1.1	1.0-1.1	0.5
Merus length/CL	0.2	0.3	0.3	0.1
Dactylus length/Cl	0.2	0.3	0.3	0.1

Abdomen of males (Fig. 36e) with all segments free, covered with rounded tubercles. One complete transverse ridge along each segment 1-3; ridges bordered by conspicuous, rounded tubercles. Male first pleopods (Figs 36f-g) with sinuous basal parts; each distal part laterally flattened; ventral tip rounded, dorsal tip with blunt, pointed processes.

Abdomen of mature females broad, rounded, covered with rounded tubercles, with all segments free, one transverse ridge along each segment 1-4 (very slight along segment 5). Abdomen of immature females unknown.

DISCUSSION. — The unique shape of the carapace of *P. ampullatus* parallels a remarkable shortening and flattening of the anterior part of the body. Several morphological changes have taken place as part of this readjustment. The epistome has expanded dorsoventrally (Fig. 36b). Each pterygostomial lobe is short and straight but it has been laterally expanded to fuse with the edges of the epistome. As a result, the inner portion of the suborbital margin is thicker and makes contact with the laterally expanded pterygostomial lobe. The third maxillipeds, which form the ventral boundary between the flat anterior portion and the rest of the body, are folded so that each merus is bent nearly 90° in relation to the straight ischium.

The unique shape and coarse tuberculation of *R. ampullatus* is most probably correlated with a particular habitat that may be unique among palicids. Perhaps it burrows in coarse sediments while leaving the flattened anterior portion of the body above the bottom. Short but dorsoventrally flattened walking legs may be involved in

Source : MNHN, Paris

digging. It may also be involved in swimming short distances, as in the case of *Exopalicus maculatus* (Edmondson, 1930) (see below).

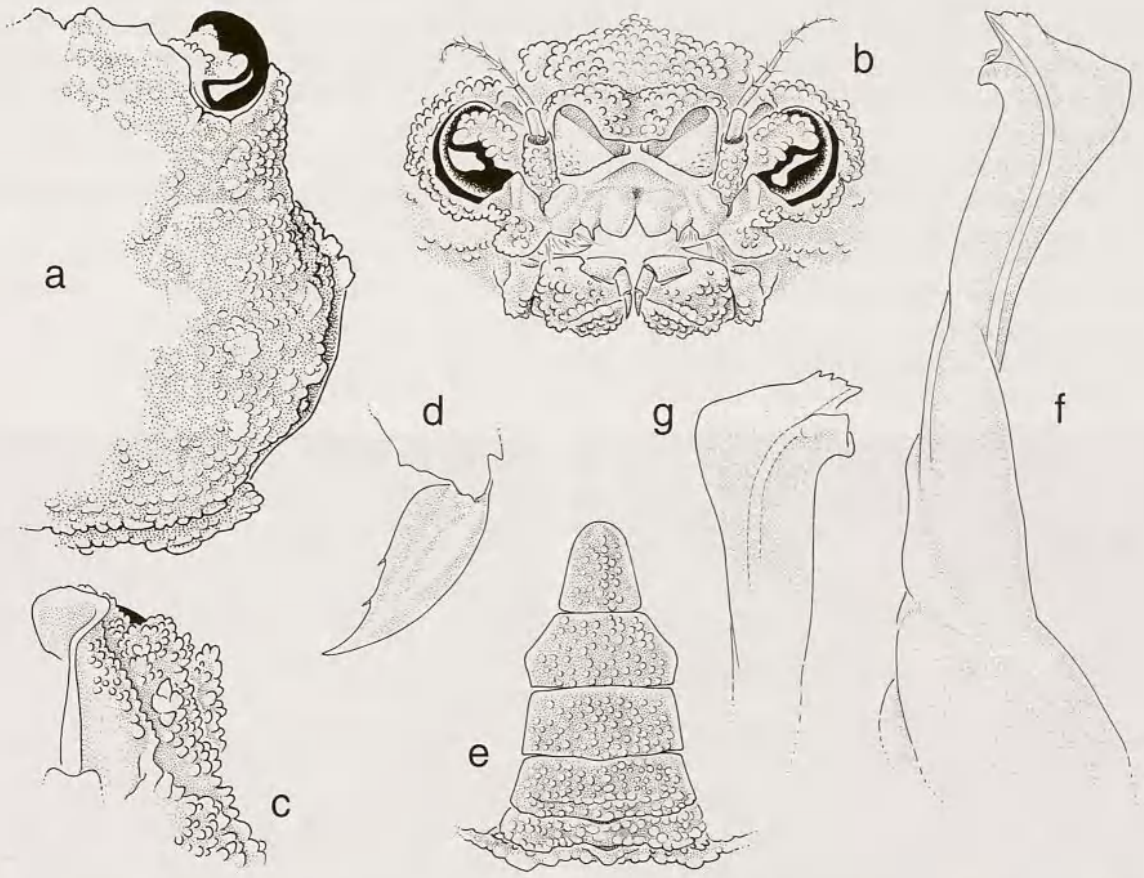


FIG. 36. — *Rectopalicus ampullatus* sp. nov., ♂ holotype 6.2 x 6.3 mm, Loyalty Islands, MUSORSTOM 6, stn DW 462, 200 m (MNHN-B 26782): **a**, carapace, dorsal view; **b**, carapace, anterior portion; **c**, suborbital border; **d**, dactylus, right fourth pereopod, dorsal view; **e**, abdomen; **f**, left male first pleopod, lateral (inner side) view; **g**, left male first pleopod, distal part, lateral (outer side) view.

SIZE. — Maximum size among specimens examined: 7.9 x 8.7 mm (female paratype; MNHN-B 26783); 6.2 x 6.3 mm (male holotype; MNHN-B 26782).

ETYMOLOGY. — From *ampulla*, Latin for bottle or flask, in reference to the unique flask-shape of the body: narrow anteriorly, wider and rounded posteriorly.

DISTRIBUTION. — Loyalty Islands and Futuna Island, southwestern Pacific Ocean. Depth: known reliably between 200 and 260 m, collected too in a trawl between 260-300 m.

Genus ***EXOPALICUS*** nov.

TYPE SPECIES. — *Palicus maculatus* Edmondson, 1930 by monotypy. Gender: masculine.

DIAGNOSIS. — Frontal border of carapace divided into two rounded, short lobes. Carapace hexagonal. Three triangular anterolateral teeth. Dorsal surface of carapace convex, covered with rounded tubercles and tuberculate

Source : MNHN, Paris

bosses. Eyes dorsoventrally flattened, wider than peduncle; peduncles with many granular tubercles. Supraorbital borders each with one short, rectangular lobe. Suborbital borders each with two short lobes. Each basal antennal segment rectangular, without distal expansion. Epistome slightly expanded dorsoventrally; two triangular median teeth. Chelipeds unequal in both sexes. First three pairs of walking legs (P2-4) with flattened (not filiform) carpi, propodi, and dactyli. First pair (P2) much shorter than second pair and third pairs (P3-4), third pair as long as second pair. Borders of meri and carpi of P2-4 with nearly equal rounded tubercles; posterior border of propodi and dactyli with short spines. Fifth pair of pereopods (P5) reduced (0.5 CL), thick. Abdomen of mature males, elongate (sides almost parallel to each other), all segments free, one transverse ridge along each segment 1-4 (may be incomplete in segment 5). Male first pleopods with sinuous basal parts; each distal part uniramous, laterally flattened, dissimilar dorsal and ventral tips with teeth. Abdomen of mature females with all segments free, one transverse ridge along each segment 1-3 (may be low in segment 4).

DESCRIPTION. — Carapace hexagonal; dorsal surface conspicuously convex and covered with rounded tubercles, some grouped into bosses. Confluence of branchial and mesogastric regions depressed. Sulcus between hepatic and branchial regions apparent. Anterolateral borders of carapace with three broad, triangular teeth. Thoracic sternite 7 with process (episternal process) at each outer edge and posterior to insertion of fifth pair of pereopods (P5), visible dorsally as oblong process.

Frontal border of carapace divided into two broad lobes. Supraorbital borders each with one short, rectangular lobe formed by two very shallow notches. Postorbital angles very short and triangular. Cornea of eyes dorsoventrally flattened, wider than base of eye peduncle; each peduncle very short, with many granular tubercles. Orbits deep, wide.

Suborbital borders each with broadly rounded, short inner and outer lobes. Pterygostomial lobe at each anterolateral angle of buccal frame with slight vertical inclination and broad, rounded to slightly pointed border.

Each basal antennal segment short, rectangular; flagellum short with few long plumose setae. Epistome broad, slightly expanded dorsoventrally. Border of epistome with two large, triangular median teeth plus two pointed outer processes fusing distally with each pterygostomial lobe. Meri of third maxillipeds narrower than ischia.

Chelipeds unequal in both sexes. Fingers thick (very short in largest cheliped), with cutting edge and no teeth. Inner surfaces of propodi of males with thick clump of plumose setae. First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair about same long as second. First three pairs of walking legs (P2-4) with flattened (not filiform) carpi, propodi, and dactyli; anterior (dorsal) and posterior (ventral) borders and dorsal and ventral surfaces of meri with nearly equal, rounded tubercles; anterior border of carpi with rounded or slightly pointed tubercles; posterior borders of propodi and dactyli with thick spines or (on dactyli) small teeth tipped by a similar spine. Last two pairs of walking legs (P3-4) each with broad coxae, having flattened, thick edged anterior and posterior borders. Fifth pair of pereopods (P5) much reduced (0.5 CL), thick; basis-ischia and meri with small tubercles; spines along posterior border of dactyli.

Abdomen of mature males elongate, with both sides almost parallel to each other, with all segments free, segments 1-2 dorsoventrally compressed, one transverse ridge along each segment 1-4 (incomplete in segment 5). Male first pleopods (Fig. 38d) with sinuous basal parts; each distal part uniramous, thick, laterally flattened, with dissimilar dorsal and ventral tips with teeth. Second male pleopods short, thin, slightly curved; distal segment with blunt tip.

Abdomen of mature females broad and rounded, with all segments free, segments 1-2 dorsoventrally compressed, one transverse ridge along each segment 1-3 (may be low in segment 4).

SPECIES INCLUDED. — Only one species is known, *Exopalicus maculatus* (Edmondson, 1930).

SEXUAL DIMORPHISM. — Males are smaller than females as in other palicids. The chelipeds are unequal in both sexes. There is a thick clump of plumose setae on the inner surfaces of the cheliped propodi in males, as in five other species of Indo-west Pacific palicids (see "Sexual Dimorphism and Mating Behavior").

DISCUSSION. — *Exopalicus* shares with *Rectopalicus* the presence of short walking legs with spines along the posterior border of the propodi. There are also some similarities in the epistome (slightly expanded dorsoventrally

Source : MNHN, Paris

as in *R. amphiceros*), male first pleopods (laterally flattened with spines, as in *R. amphiceros*; Figs 35d-e), and conspicuous rounded tubercles on the carapace and appendages as in *R. ampullatus*. Nevertheless, the hexagonal, dorsally convex (almost rounded) shape of its carapace, large and triangular anterolateral teeth, and complex male first pleopods with terminal and lateral teeth of different sizes and shapes set it apart from the subquadrate or pyriform carapace and body plan of *Rectopalicus* and its simpler male first pleopod. Other characteristic features of *Exopalicus* are the very short eye peduncles and postorbital angles (perhaps as a result of the rounding of the carapace), more conspicuous episternal process, and the presence of only one very short lobe on each supraorbital border.

The walking legs and fifth pair of pereopods are shorter in relation to carapace size in *Exopalicus* than in other Indo-west Pacific palicids. The shortening of the walking legs may be an adaptation to living in hard substrate habitats, such as coral, where swimming is very much limited.

No known species of western Atlantic or eastern Pacific palicids resembles the general body plan of *Exopalicus*.

ETYMOLOGY. — From *ex*, Latin for out of, and the generic name *Palicus*, in reference to the unique triangular outline of the conspicuously convex carapace, which sets it apart from other genera of palicids.

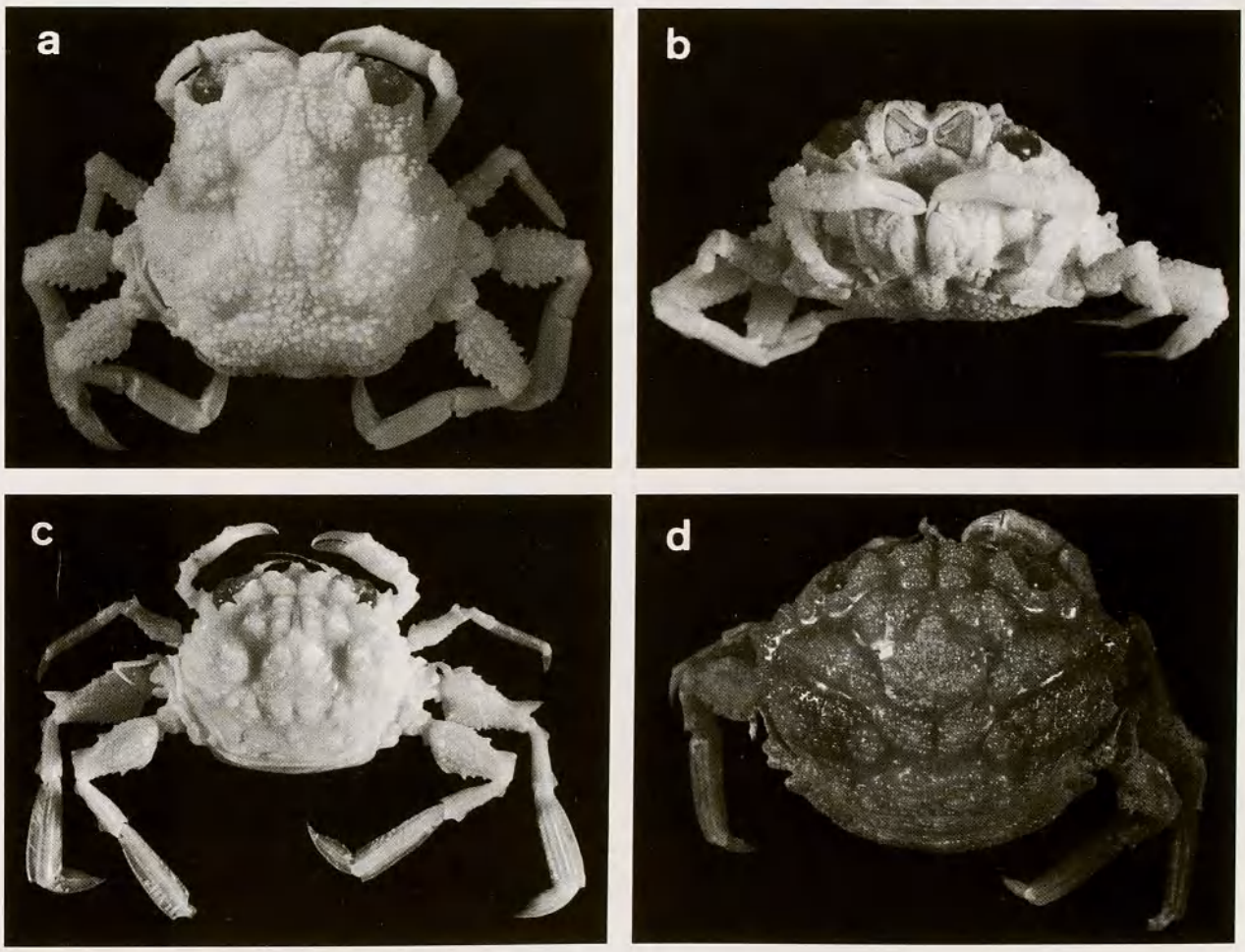


FIG. 37. — **a-b**, *Rectopalicus ampullatus* sp. nov., ♂ holotype 6.2 x 6.3 mm, Loyalty Islands, MUSORSTOM 6, stn DW 462, 200 m (MNHN-B 26782): **a**, dorsal view; **b**, anterior view of carapace. — **c**, *Rectopalicus woodmasoni* (Alcock, 1900), ♀ 9.4 X 10.3 mm, off southwest coast of New Caledonia, BATHUS 2, stn CP 728, 241-245 m (MNHN-B 26774): dorsal view. — **d**, *Exopalicus maculatus* (Edmondson, 1930), ♀ 9.5 x 13.1 mm, Oahu, Hawaiian Islands, J. HOOVER & D. DICKEY coll., 3-4 m (MNHN-B 26784): dorsal view.

Source : MNHN, Paris

Exopalicus maculatus (Edmondson, 1930)

Figs 37d, 38, 56, 61b

Palicus tuberculatus Edmondson, 1925: 57, figs 8e-g, pl. 4, figs A-G; 1933: 268; 1946: 310.
Palicus maculatus Edmondson, 1930: 15, figs 6a-g, pl. 1, fig. C; 1933: 268, fig. 158c; 1946: 310, fig. 184c.
Cymopolia medipacifica Edmondson, 1962: 9, figs 4a-c.
Cymopolia maculata - Edmondson, 1962: 11, figs 4d-e.
Pseudopalicus sp. - Hoover, 1998: 287, unnumb. fig.

Material examined. — **La Réunion**. Cap Houssaye, night diving, on *Millepora* coral, 15 m, J. Beneteau coll., 10.1973: 1 ♂ 5.5 x 7.2 mm, 1 ♀ 5.6 x 6.8 mm (MNHN-B 26785).

Marshall Islands. *Enewetak Atoll.* Parry Island, lagoon, 3-5 m, J.S. Garth coll., 22.07.1957: 1 ♂, 1 ♀ (LACM).

Hawaiian Islands. *Oahu.* Waikiki, Ostergaard coll., 11.1922: 1 ♂, 1 ♀ (BPBM 932). — Waikiki, 1923: 1 ♀ (BPBM 3266). — Waikiki, 30.03.1930: 1 ♂ holotype of *Palicus maculatus* Edmondson, 1930, 5.6 x 7.2 mm (BPBM 3337). — Honolulu, Ala Moana Beach Park, Magic Island Boat Channel, rock wall, night diving, 5 m, J. Hoover coll., 7.10.1997: 1 ♀ (QM W24746); rock wall, night diving, 3-4 m, J. Hoover & D. Dickey coll., 17.06.1999: 1 ♀ 9.5 x 13.1 mm (MNHN-B 26784); on boulders, night collection, 1 m, D. Takaoka coll., 1.08.1999: 1 ♀ 9.8 x 14.0 mm (MNHN-B 26999). — Blow Hole, 18 m, R. Holcom coll., 02.1996: 1 ♂ (QM W21847); 15 m, 01.1997: 2 ♂ 7.1 x 10.2 mm, 7.4 x 10.3 mm (QM W24745).

Molokai. Kaunakakai, Ball & C.H. Edmondson coll., 22.02.1922: 1 ♀ (BPBM 940).

Types. — *Holotype* of *Palicus tuberculatus* Edmondson, 1925 apparently lost: 1 ♀ 9 x 12 mm, Ocean (= Kure) Island, 28°25'N, 178°25'W, "shallow water on the reef" (Edmondson, 1925) (BPBM 1134).

Holotype of *Palicus maculatus* Edmondson, 1930: 1 ♂ 5.6 x 7.2 mm, Oahu, Hawaiian Islands (BPBM 3337).

Type Locality. — Waikiki reef, Oahu, Hawaiian Islands, shallow water.

Diagnosis. — Carapace (Figs 37d, 38a) with three triangular, broadly pointed anterolateral teeth on each side; large tubercle posterior to postorbital angle, several small, rounded tubercles between the anterolateral teeth. Dorsal surface of carapace convex, with many rounded tubercles and tuberculate bosses. Supraorbital borders each with two shallow notches resulting in one very short lobe. Suborbital borders (Fig. 38b) each with very broad, short inner and outer lobes. Dorsal borders of cheliped propodi with rounded tubercles. Dactyli of walking legs (P2-4) with thick spines along posterior borders (one tooth in P4; Fig. 38c). Abdomen of mature males with all segments free, one complete transverse ridge along each segment 1-4, incomplete ridge along median portion of segment 5. Male first pleopods (Fig. 38d) with sinuous basal parts; each distal part with one flattened process with teeth. Abdomen of mature females with all segments free, one complete transverse ridge along each segment 1-3 (low ridge along segment 4).

Color: Individuals photographed live in Hawaii show a very wide range of color patterns: pink carapace with large red dots (Fig. 61b), pink with irregular white markings (Hoover, 1998: 287, unnumbered figure), irregular bright or light orange spots, and bright red carapace and white legs. Another was described as "dull, dark grayish brown" (Hoover, personal communication).

Discussion. — This species was described as *Palicus tuberculatus* by Edmondson (1925). The holotype (BPBM 1134) is apparently lost, but three specimens identified by Edmondson as *P. tuberculatus* and mentioned by him in the description (BPBM 940, BPBM 942) agree with the actual description. One exception, however, is in the number of anterolateral teeth on each side of the carapace. Edmondson (1925: 57; pl. 4, figs A, E) gives its number as five but the number, shape, and relative length vary widely among the specimens examined in this study, even between the right and left side of the same individuals. For example, a male identified by Edmondson (BPBM 932) had four obvious teeth and tubercles on the left side but five on the right. The anterolateral teeth are perhaps more correctly given as three. Most, in not all of the teeth typically have a small, rounded tubercle on one or both sides (Figs 37d, 38a). There is also a conspicuous, rounded tubercle posterior to the postorbital angle that can be almost as large as the first tooth, particularly in small individuals.

Palicus maculatus Edmondson, 1930, which is known only from one male collected from shallow-water coralline algae in Hawaii (5.6 x 7.2 mm; BPBM 3337), is clearly a small specimen of *P. tuberculatus*.

Source : MNHN, Paris

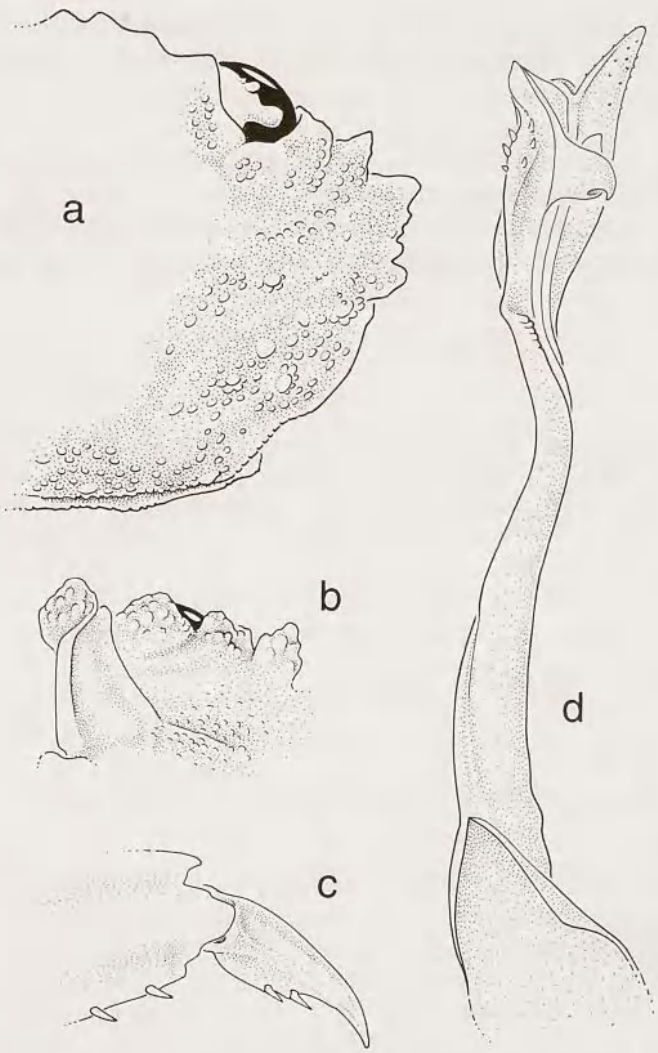


FIG. 38. — *Exopalicus maculatus* (Edmondson, 1930), ♂ 7.4 x 10.3 mm, Blow Hole, Oahu, Hawaiian Islands, 15 m (QM W24745): **a**, carapace, dorsal view; **b**, suborbital border; **c**, dactylus, right fourth pereopod, dorsal view; **d**, left male first pleopod, lateral (outer side) view.

EDMONDSON (1930: 17) distinguished *P. maculatus* from *P. tuberculatus* by having a smaller fifth anterolateral tooth ("as long as the fourth, but narrower" than *P. tuberculatus*), tubercles on the "upper and lower surfaces" less prominent, and the fingers of the chelipeds "less deflexed and the inner borders of the hands are free from hair". These characters fall within the range of morphological variation of the species. One exception, however, is the absence of the thick clump of plumose setae that characterizes males of *P. maculatus*. It is possible that the setae were absent in the holotype after almost seventy years of preservation or that perhaps this is a character absent in small males. Furthermore, EDMONDSON's figures of the holotype were incorrect. The holotype has four anterolateral teeth, the second is the largest and the last two are located on an almost straight line posterior to it. The figure, however, shows what might be interpreted as two rounded teeth anterior to a large, pointed tooth and two broad, rounded teeth posterior to it.

EDMONDSON's living specimen was described as having a "broad crimson band" across the propodi of the walking legs and chelipeds and a large crimson spot on a depression behind each eye (EDMONDSON, 1930: 15, pl. 1, fig. C). The dark band across each second pair of walking legs that is shown in EDMONDSON's photograph is similar to that shown in the holotype of *R. ampullatus* (Fig. 61a). A specimen photographed live in Hawaii (HOOVER, 1998: 287, unnumbered figure) was cryptically colored pink and with irregular white markings on the carapace and walking legs. A female (9.5 x 13.1 mm; MNHN-B 26784) that had been preserved in alcohol for 18 days showed numerous, small red dots on the dorsal surfaces of the chelipeds, meri of walking legs, and borders of the carapace.

The name of *P. tuberculatus* was subsequently changed by EDMONDSON (1962: 8) to *P. medipacificus* (Edmondson, 1962) (as *Cymopolia medipacifica*) since the name was already preoccupied by *Cymopolia tuberculata* Faxon, 1895, a western Atlantic species. *P. maculatus* Edmondson, 1930, however, takes precedence since the name was used in 1930 for a junior subjective synonym.

All pereopods of *E. maculatus* are particularly short when compared with other palicids. The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	0.9	1.1-1.2	1.1	0.5
Merus length/CL	0.3	0.3	0.3	0.1
Dactylus length/CL	0.1-0.2	0.2	0.2	0.1

Source : MNHN, Paris

There are 5-6 spines each along the posterior border of the propodi of P2-P3, and 7-8 in P4. Each dactylus of the walking legs is armed with a 1-2 teeth, each capped by a thick spine (Fig. 38c). The P5 are very short, the ischia and meri have small but conspicuous tubercles, and the posterior borders of the meri and dactyli are each armed with two and one spine respectively.

E. maculatus is known only from few locations at the extreme ends of the Indo-west Pacific region: the southwestern Indian Ocean and the north-central Pacific Ocean. Most specimens have been collected at night. It appears that individuals hide in coral and other hard substrates and emerge at night. Their nocturnal habits (see HOOVER, 1998: 287), small size, and cryptic coloration should explain their puzzling absence in collections from other Indo-west Pacific locations.

SIZE. — Maximum size among specimens examined: 8.4 x 11.1 mm (male, LACM), 9.8 x 14.0 mm (female, MNHN-B 26999).

DISTRIBUTION. — Known from the Hawaiian Islands and Kure Island (EDMONDSON, 1925, 1930, 1933, 1946, 1962; some records as *P. tuberculatus* or *Cymopolia medipacifica*) but its range now includes the Marshall Islands, and La Réunion, southwestern Indian Ocean (Fig. 56). Depth: "shallow water" (EDMONDSON, 1925, 1930) to 18 m.

Genus ***NEOPALICUS*** Moosa & Serène, 1981

Neopalicus Moosa & Serène, 1981: 41.

TYPE SPECIES. — *Cymopolia jukesii* White, 1847 by original designation (MOOSA & SERÈNE, 1981). Gender: masculine.

DIAGNOSIS. — Carapace subquadrate; frontal border divided into two large lobes followed by distinct notch on each side. Anterolateral borders each with two large truncate teeth (similar but shorter teeth may be posterior to first two). Dorsal surface of carapace with large, low granules in horizontal rows, very low bosses. Eyes spherical; each peduncle with one conspicuous, granular, median tubercle and two smaller, granular or soft tubercles. Supraorbital borders each with 1-2 triangular lobes. Suborbital borders with two large, triangular, dentiform lobes. Each basal antennal segment expanded into thick, flat process or two wing-like expansions. Epistome expanded dorsoventrally, forming broad, semicircular, nearly flat surface; thin carina-like process along median portion without protruding median teeth. Chelipeds equal or nearly equal in males and females, slender in females, heavier in males. First three pairs of walking legs (P2-4) with flattened (not filiform) carpi, propodi, and dactyli. First pair (P2) shorter than second and third pairs (P3-4); third pair about as long as second pair. Meri of P2-4 oval in shape, borders with thick tubercles or triangular teeth. Anterior borders of propodi of P3-4 with conspicuously wide, convex enlargement; posterior border of dactyli entire. Fifth pair of pereopods (P5) reduced (0.7-0.8 CL), thick; rows of thick spines along posterior border of propodi. Abdomen of mature males elongate (sides almost parallel to each other), all segments free, one transverse ridge along each segment. Male first pleopods long and slender; basal parts sinuous; each distal part biramous. Abdomen of mature females with all segments free, one transverse ridge along each segment.

RÉDESCRIPTION. — Carapace subquadrate, slightly broader than long, with large, low granules arranged in horizontal bands. Anterolateral borders straight or slightly curved, each with two truncate teeth. Confluence of branchial and mesogastric regions depressed and smooth. Conspicuous sulcus between hepatic and branchial regions. Thoracic sternite 7 with reduced process (episternal process) at each outer edge and posterior to insertion of fifth pair of pereopods (P5), visible dorsally as elongate or slightly rounded process below posterolateral border of carapace. Posterior border of carapace smooth, without protruding tubercles or plumose setae.

Frontal border divided into two rounded lobes; distinct, wide notch separates frontal lobes on each side from folded, slightly rounded border ending in sharp angle forming V-shaped fissure at supraorbital border. Supraorbital

Source : MNHN, Paris

borders each with 1-2 triangular lobes. Postorbital angles relatively short (never extending above retracted eyes), pointed. Cornea of eyes spherical, almost as wide as base of peduncle; each peduncle with one conspicuous, rounded, granular, median tubercle and two smaller, granular or soft tubercles. Orbits deep.

Suborbital border with two triangular, dentiform lobes. Pterygostomial lobe at each anterolateral angle of buccal frame projects ventrally, sinuous edge.

Antennules short, thick, and transversely folded beneath front; interantennular septum narrow. Each basal antennal segment expanded into thick, dorsoventrally flattened, scale-like process or two thin, wing-like, anterior expansions. Epistome expanded dorsoventrally, forming nearly flat surface between antennular fossae and anterior border of endostome; no median teeth, only low, thin, carina-like process along median portion, flanked at same level by two outer lobes that connect with each pterygostomial lobe. Meri of third maxillipeds smaller, narrower than ischia.

Chelipeds equal or nearly equal in males and females, long, slender in females and shorter, thicker in males (very thick propodus in largest males). Fingers of chelipeds with triangular teeth (broadly rounded teeth in very large chelipeds of largest males), pollex becoming flatter with increasing size. First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair slightly shorter or as long as second. First three pairs of walking legs (P2-4) with flattened (not filiform) carpi, propodi, and dactyli. Meri slightly oval (not much more longer than wide); anterior (dorsal) and posterior (ventral) borders with thick, unequal tubercles or triangular teeth, rows of tubercles on dorsal and ventral surfaces. Elongate (but not filiform and conspicuously slender) propodi and dactyli; posterior borders entire. Last two pairs of walking legs (P3-4) each with slightly broadened coxae, having slightly flattened, thick-edged anterior and posterior borders. Anterior borders of propodi of P3-4 with conspicuously wide, convex enlargement. Fifth pair of pereopods (P5) reduced (0.7-0.9 CL), thick; basis-ischia and meri long and tuberculate; propodi with 2-3 rows of very thick spines along posterior border; dactyli thick and slightly curved.

Abdomen of mature males elongate, with both sides almost parallel to each other, with all segments free, segments 1-2 dorsoventrally compressed, one transverse ridge along each segment. Male first pleopods long and slender; basal parts sinuous; each distal part biramous. Second male pleopods short, thin, slightly curved; distal segment with blunt tip.

Abdomen of mature females broad, rounded, with all segments free, segments 1-2 dorsoventrally compressed, one transverse ridge along each segment. Abdomen of immature females triangular (but broader than in males), segments 1-2 dorsoventrally compressed, segments 3-6 fused, transverse ridge along each segment 1-2 plus two along proximal portion of fused segments 3-6.

SPECIES INCLUDED. — *N. contractus* (Rathbun, 1902) and *N. jukesii* (White, 1847).

SEXUAL DIMORPHISM. — As in other palicids, females are considerably larger in size than males. The chelipeds are equal or nearly equal in both sexes. They are slender in females but heavier in males. There is no evidence of differences in the length or shape of the walking legs or the fifth pair of pereopods.

DISCUSSION. — The description of *Neopalicus* by MOOSA & SERÈNE (1981) included the most important characters of this small and relatively homogeneous genus. As in the other Indo-west Pacific genera, however, its description has been expanded to include several new characters, even though no new species are described here.

Neopalicus is morphologically similar to *Palicoides* Moosa & Serène, 1981. The four species included in these two genera are adapted to live in coarse sediments in relatively shallow water in or near coral reefs. Two and even three of the four species in the two genera have been repeatedly collected together from the same stations in the Coral Sea region. There are sharp differences between these four species and the species included in the other palicid genera (see Table 1), most of which are inhabitants of finer sediments in deeper waters. Many of these differences are seemingly the result of morphological and behavioral adaptations to their particular habitats. Unfortunately, nothing is known about the habits of the four species of *Neopalicus* and *Palicoides* but it is assumed that they bury in the sand (that is, they cover themselves with sand without forming burrows) at least during part of the day.

Species of *Neopalicus* and *Palicoides* share a subquadrate carapace, large and low tubercles that do not form bosses, and thick fifth pereopods (Figs 39, 42). They even have a similar color pattern (Figs 61 c-e). *Neopalicus*

Source : MNHN, Paris

species are characterized by three rounded tubercles on each eye peduncle, the largest of which is round, high and granular, while there is a very conspicuous, larger, crescent-shaped (thin, rounded, and with pointed tip) process on each peduncle in *Palicoides* species (see Table 1). Another character that is diagnostic in *Neopalicus* is the expansion of the anterior borders of the propodi of the second and third pair of walking legs (P3-4) as a wide and convex enlargement. Such an expansion is absent in the legs of *Palicoides*. Segments 2-3 of the antennae (Fig. 42a) are expanded and provided with long setae in *Palicoides*, whereas they are slender in *Neopalicus* as in most other Indo-west Pacific palicids (Figs 40a-c).

No described species of palicids from outside the Indo-west Pacific region show the subquadrate, flat carapace, and thickened fifth pereopods characteristic of *Neopalicus*.

Key to the species of *NEOPALICUS*

1. Carapace widest at level of first anterolateral tooth, lateral borders convergent posteriorly (Fig. 39a). Basal antennal segment thick, scale-like (Fig. 40a) ..... ***N. contractus*** (Rathbun, 1902)

— Carapace widest at level of second anterolateral tooth, lateral borders not convergent posteriorly (Fig. 39b). Basal antennal segment with two thin, nearly equal, wing-like processes (Figs 40b-c) ..... ***N. jukesii*** (White, 1847)

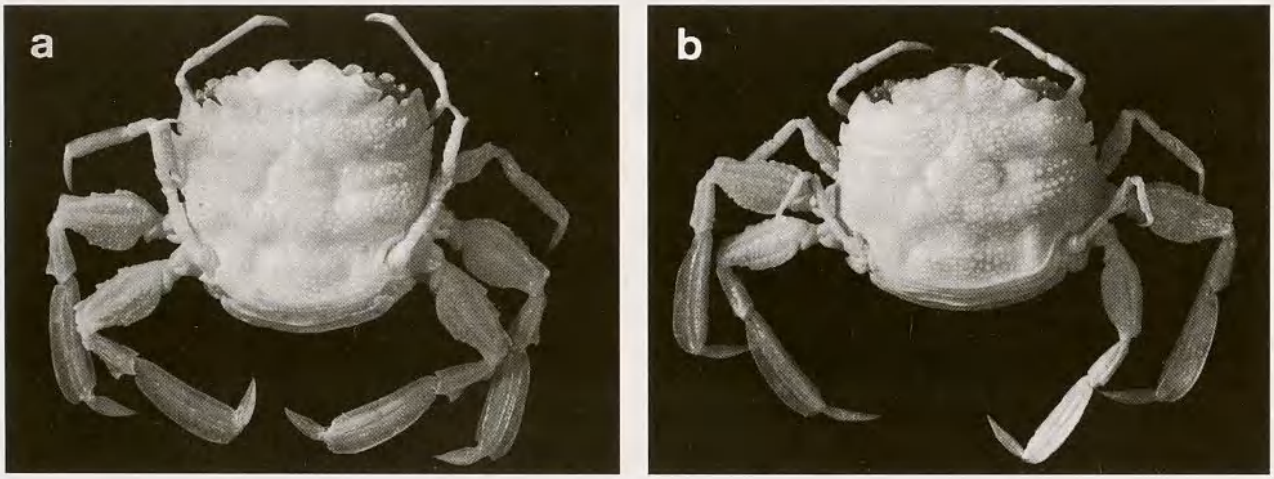


FIG. 39. — **a**, *Neopalicus contractus* (Rathbun, 1902), ♀ 14.2 x 15.7 mm, Chesterfield Islands, CORAIL 2, stn DW 65, 62 m (MNHN-B 26788): dorsal view. — **b**, *Neopalicus jukesii* (White, 1847), ♀ 8.1 x 9.6 mm, east coast of New Caledonia, LAGON, stn 713, 34-35 m (MNHN-B 26996): dorsal view.

Neopalicus contractus (Rathbun, 1902)

Figs 39a, 40a, 41a-b, 49

Palicus contractus Rathbun, 1902: 126, figs 7-8. — SERÈNE, 1968: 96.
Palicus jukesi - LAURIE, 1906: 430, pl. 1, fig. 12 [non *Neopalicus jukesii* (White, 1847)].
Cymopolia robusta Ward, 1942a: 46, pl. 4, figs 3-4; 1942b: 53. — MICHEL, 1964: 33; 1974: 134. — GUINOT, 1967: 280.
Palicus robustus - SERÈNE, 1968: 96.
Neopalicus contractus - MOOSA & SERÈNE, 1981: 44, pl. 2, fig. D.
Palicus jukesi - GARTH *et al.*, 1987: 259 [non *Neopalicus jukesii* (White, 1847)].
non *Palicus contractus* - ZARENKOV, 1968: figs 3Д, E [*P. contractus* in caption and English summary, *P. jukesii* in text; fig. 3Д = *Paliculus kyusyuensis* (Yokoya, 1933), fig. 3E = *N. jukesii* (White, 1847)].

Source : MNHN, Paris

MATERIAL EXAMINED. — **Seychelles**. REVES 2: stn 17, 05°44.8'S, 56°39.1'E, 55 m, coralline algae, 5.09.1980: 1 ♂, 1 ♀ (MNHN-B 27149). — Stn 18, 05°43.2'S, 56°34.0'E, 50 m, shelly sand, 5.09.1980: 1 ♀ (MNHN -B 27147). — Stn 38, 05°03.5'S, 56°50.5'E, 44 m, coralline algae and dead coral, 13.09.1980: 1 ♀ (MNHN-B 27145). — Stn 52, 03°52.8'S, 55°25.3'E, 60 m, sand, 16.09.1980: 1 ♀ (MNHN-B 27144).

Maldives. *Miladummadulu Atoll*. Nallandu Island, 44 m, A. AGASSIZ coll., 18.01.1902: 1 ♂ lectotype of *Palicus contractus* Rathbun, 1902 4.9 x 7.5 mm (MCZ 6699).

South Nilandu Atoll. J.S. GARDINER coll.: 1 ♂, 1 ♀ (UMZ).

Sri Lanka. *Gulf of Manaar*. W.A. HERDMAN coll.: 1 ♂ (BMNH 1934.1.16.164).

Philippine Islands. MUSORSTOM 3: stn DR 137, 12°03'N, 122°06'E, 56 m, 6.06.1985: 3 ♀ (MNHN-B 27143).

Chesterfield Islands - Chesterfield-Bellona Plateau. CHALCAL 1: stn D 43, 20°41.50'S, 158°38.40'E, 78 m, *Halimeda* sand, 07.1984: 1 ♂ (MNHN-B 27151). — Stn D 45, 20°48.93'S, 158°30.21'E, 50 m, 07.1984: 1 ♀ (MNHN-B 27154). — Stn D 52, 21°13.40'S, 158°49.20'E, 69 m, 07.1984: 1 ♂ (MNHN-B 27155). — Stn D 53, 21°19.50'S, 158°05.30'E, 60 m, 07.1984: 3 ♂ (MNHN-B 27148). — Stn D 55, 21°23.90'S, 158°59.60'E, 55 m, *Halimeda* and foraminiferans, 07.1984: 1 ♂ (MNHN-B 27150). — Stn D 56, 21°24.40'S, 159°08.80'E, 60 m, *Halimeda* and foraminiferans, 07.1988: 1 ♂ 10.8 x 12.0 mm (MNHN-B 26789), 1 ♀ (MNHN-B 27139).

CORAIL 2: stn DW 2, 20°55.90'S, 161°40.70'E, 62 m, boulders and *Halimeda*, 28.07.1988, 1 ♀ (MNHN-B 27156). — Stn DW 18, 20°44.08'S, 160°59.92'E, 69 m, 21.07.1988: 1 ♀ (MNHN-B 27142). — Stn DW 61, 19°14.96'S, 158°53.60'E, 54 m, *Halimeda* sand, 24.08.1988: 1 ♀ (MNHN-B 27152). — Stn DW 65, 19°15.00'S, 158°40.64'E, 62 m, *Halimeda* sand, 24.08.1988: 1 ♀ 14.2 x 15.7 mm (MNHN-B 26788). — Stn DW 80, 19°11.98'S, 158°47.01'E, 66 m, *Halimeda* sand, 25.08.1988: 1 ♀ (MNHN- B 27141). — Stn DW 94, 19°06.00'S, 158°50.00'E, 36-53 m, boulders and *Halimeda*, 27.08.1988: 1 ♀ (MNHN-B 27146).

Bellona Reefs. Stn 2 DE, 21°21.5'S, 158°48.0'E, 61-64 m, 19.10.1985: 1 ♀ (MNHN-B 27153). — Stn 7 DE, 21°21.0'S, 158°52.7'E, 56-58 m, 19.10.1985: 2 ♂ (MNHN-B 27140).

New Caledonia. LAGON: stn 392, 22°48.2'S, 167°02.3'E, 80 m, shell debris, foraminiferans, 22.01.1985: 1 ♀ 17.3 x 18.6 mm (MNHN-B 26786).

SMIB 5: stn DW 100, 23°22.9'S, 168°05.2'E, 80-120 m, sand, 14.09.1989: 1 ♂ 12.9 x 14.0 mm (MNHN-B 26787).

Marshall Islands. *Enewetak Atoll*. Stn 423, J.W. KNUDSEN coll., 14.08.1967: 1 ♂ (LACM). — Stn 429, 15.08.1967: 1 ♀ (LACM). — Stn 187: 1 ♀ (LACM).

TYPES. — *Lectotype* of *Palicus contractus* Rathbun, 1902: 1 ♂ 4.9 x 7.5 mm, 1 ♂ paralectotype, Maldives (MCZ 6699).

Holotype of *Cymopolia robusta* Ward, 1942: 1 ♀ CW 16 mm (WARD, 1942), Mauritius. Deposit unknown: Mauritius Institute, Port Louis, Mauritius ?

TYPE LOCALITY. — Nallandu Island, Miladummadulu Atoll, Maldives, 44 m.

DIAGNOSIS. — Carapace (Fig. 39a; RATHBUN, 1902, fig. 7; MOOSA & SERÈNE, 1981, pl. 2, fig. D) subquadrate, with large, low granules; lateral borders wider anteriorly than posteriorly so that widest extension of carapace at level of first and larger of two anterolateral teeth. Supraorbital borders each with one triangular inner lobe, one short outer lobe. Suborbital borders (Fig. 40a) each with two triangular, tooth-like lobes. Each basal antennal segment (Fig. 40a) with thick, dorsoventrally flattened process along outer border, much shorter, elongate process along inner border. Dorsal borders of cheliped propodi with rounded, microscopic tubercles, much more pronounced in thick chelipeds of large males; outer borders with hook-like setae. Dorsal and ventral sides and upper and lower borders of meri of second and third pairs of walking legs (P3-4; Fig. 39a) with conspicuous tubercles; anterior borders of carpi of P3-4 with similar tubercles; anterior borders of propodi with conspicuously wide, convex enlargement. Abdomen of mature males narrow, with all segments distinct; one transverse ridge along each segment. Male first pleopods (Figs 41a-b) with sinuous basal parts; each distal part biramous, with one flattened, anterior tip with four pointed teeth, and long, curved extension with teeth along dorsal border extending immediately above toothed base. Abdomen of mature females with all segments distinct, one transverse ridge along each segment (less pronounced and curved in median portion in segment 6).

DISCUSSION. — This is the first time the male pleopod of *N. contractus* is described and illustrated. The figure of the male pleopod given by ZARENKOV (1968, fig. 3E) is actually that of *N. jukesii*, although it is correctly identified in the text (ZARENKOV, 1968: 765). The ventral view of the anterolateral portion of the carapace that is identified as *N. jukesii* in the text and as *N. contractus* in the caption (ZARENKOV, 1968, fig. 3Д, 765) does not

Source : MNHN, Paris

belong to *Neopalicus* but to *Paliculus kyusyuensis* (Yokoya, 1933) instead. To add to the confusion, *N. contractus* and not *N. jukesii*, is listed in the English summary (ZARENKOV, 1968: 766)!

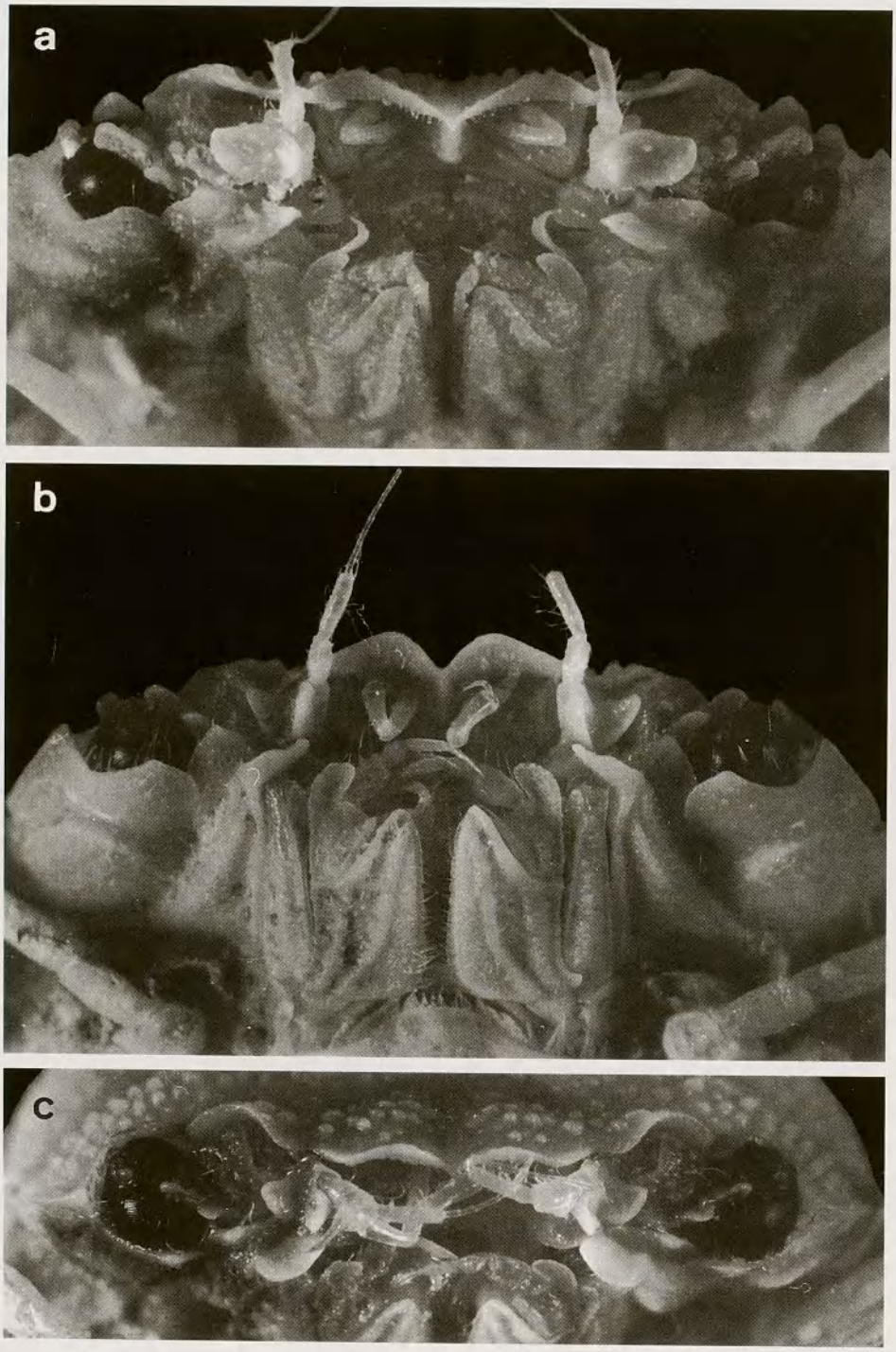


FIG. 40. — **a**, *Neopalicus contractus* (Rathbun, 1902), ♀ 14.2 x 15.7 mm, Chesterfield Islands, CORAIL 2, stn DW 65, 62 m (MNHN-B 26788): ventral view of anterior portion of carapace. — **b-c**, *Neopalicus jukesii* (White, 1847): ♀ 8.1 x 9.6 mm, east coast of New Caledonia, LAGON, stn 713, 34-35 m (MNHN-B 26996): **b**, ventral view of anterior portion of carapace; **c**, anterior view of carapace.

Source : MNHN, Paris

Although the chelipeds are long, slender, and equal in immature males, they become thicker with increasing size. In the largest male examined in this study, a specimen from New Caledonia (12.9 x 14.0 mm; MNHN-B 26787), the right cheliped was greatly enlarged, much more than the chelipeds in the second largest male (10.8 x 12.0 mm; MNHN-B 26789). A large male from the Maldives (UMZ) that was not measured, also had an enlarged right cheliped. The fingers of the enlarged cheliped were short and very thick. The propodus and fingers of the left cheliped were missing but the segments that remain were only slightly smaller than those of the right cheliped. The male first pleopods and other morphological characters of the largest specimens agreed with those of smaller males.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	0.9-1.0	1.5	1.5-1.6	0.8-0.9
Merus length/CL	0.3	0.4	0.4-0.5	0.2-0.3
Dactylus length/Cl	0.2	0.2-0.3	0.5	0.1-0.2

The fifth pair of pereopods (P5; Fig. 39a) is typical of *Neopalicus*, with thick, tuberculate segments (except dactylus), very thick spines along the posterior border of the propodus, and a slightly curved dactylus.

Most specimens of *N. contractus* can be easily distinguished from *N. jukesii*, a close species (see Table 3). Nevertheless, both species can be confused when there is limited material or only small specimens, as demonstrated by repeated mistakes in the literature. The shape of the carapace is a relatively stable character but the shape of the anterolateral teeth tends to overlap, particularly in small specimens and in large females.

The shape of each basal antennal segment is a much more reliable character. It has a conspicuous, thick, scale-like process as well as a smaller, inner process (Fig. 40a) in contrast to the two thin, nearly equal, wing-like processes (Figs 40b-c) in *N. jukesii*. In their key to the species of *Neopalicus*, MOOSA & SERÈNE (1981: 41) characterized the basal antennal segment of *N. jukesii* as having a "subacutely carinate" anterolateral angle in contrast to a "bilobed process" on the anterolateral angle of *N. contractus*. It seems that both characters were reversed since it is difficult to characterize the segment in *N. contractus* as "bilobed" (unless the inner prominence was considered a lobe) and one of the two wing-like expansions in *N. jukesii* was interpreted as a carina.

MOOSA & SERÈNE (1981: 41) also included in the key they used to separate between the two species a difference in the relative length of the dactylus of P4 in relation to the length of the propodus, the dactylus being less than half the propodus length in *N. contractus* but more than half in *N. jukesii*. This was found not to be the case in the many specimens that were examined in this study. The dactylus length to propodus length ratio was found to vary between 1:1.8 to 1:1.9 in both species.

Cymopolia robusta Ward, 1942 can be identified as a subjective junior synonym of *N. contractus* from the photograph that accompanied its description (WARD, 1942a). The holotype, supposedly at the Mauritius Institute, was unavailable for examination. As previously mentioned by MOOSA & SERÈNE (1981: 44), the characters used by WARD (1942a) to separate his species from *N. jukesii* also apply when *N. contractus* is compared with *N. jukesii*.

RATHBUN (1902) based her description of *Palicus contractus* on two specimens without selecting a holotype. One of the two syntypes (♂ 4.9 x 7.5 mm, MCZ 6699) is hereby designated as the lectotype and the second male specimen as a paralectotype.

SIZE. — Maximum size among specimens examined: 17.3 x 18.6 mm (female, MNHN-B 26786); 12.9 x 14.0 mm (male, MNHN-B 26787).

DISTRIBUTION. — Mauritius (WARD, 1942a, 1942b; as *Cymopolia robusta*), Maldives (RATHBUN, 1902), Sri Lanka (LAURIE, 1906, as *Palicus jukesi*), and Ceram and Kai islands, Indonesia (MOOSA & SERÈNE, 1981). It is here recorded for the first time from the Seychelles, Philippine Islands, the Coral Sea (Chesterfield Islands, Bellona Reefs, and New Caledonia), and the Marshall Islands (Fig. 49). It has been repeatedly collected from coarse sand rich in coral, coralline algae, and shell rubble. In the Coral Sea, it has been collected together with *N. contractus*

Source : MNHN, Paris

and the two species of *Palicoides*. Depth: known reliably between 44 and 80 m; also collected in trawls between 36-53 m and 80-120 m.

Neopalicus jukesii (White, 1847)

Figs. 39b, 40b-c, 41c, 49, 61c

Cymopolia jukesii White, 1847a: 54 [nomen nudum].
Cymopolia jukesii White, 1847b: 338, pl. 2, fig. 1; 1861: pl. 2. — MIERS, 1874: 3, pl. 3, figs 4, 4a-c; 1886: 335. — HASWELL, 1882: 138. — HENDERSON, 1893: 405.
Cymopolia carinipes Paulson, 1875: 76, pl. 9, figs 4, 4a; 1961: 79, pl. 9, figs 4, 4a.
Palicus jukesii - BOUVIER, 1897: 65. — ALCOCK, 1900: 451. — CALMAN, 1900: 29, pl. 1, figs 9-13. — DE MAN, 1902: 545. — RATHBUN, 1902: 126; 1911: 240, pl. 19, fig. 9. — LAURIE, 1915: 416. — NOBILI, 1906a: 325. — ZARENKOV, 1968: 765, fig. 3E [*P. contractus* in caption and English summary]; 1971: 173.
Palicus jukesi - BORRADAILE, 1903: 433. — SERÈNE, 1968: 96.
Cymopolia jukesi - GUINOT, 1967: 280.
Palicus carinipes - HOLTHUIS, 1977: 181, fig. 2.
Neopalicus jukesi - MOOSA & SERÈNE, 1981: 42, fig. 7, pl. 2, fig. C.
non *Palicus jukesii* - LAURIE, 1906: 430, pl. 1, fig. 12 [= *Neopalicus contractus* (Rathbun, 1902)].
non *Palicus jukesii* - ZARENKOV, 1968: fig. 3Д [*P. contractus* in caption = *Paliculus kyusyuensis* (Yokoya, 1933)].

MATERIAL EXAMINED. — **Gulf of Aden**. *"Meteor"*: stn Me5-236 Ku, 12°21.2'N-12°19.0'N, 43°27.1'E-43°27.8'E, 35-45 m, 6.03.1987: 5 ♂, 19 ♀, 21 juv. (SMF 24709), 3 ♂, 4 ♀ (SMF 24710).

Comoro Islands. *Mayotte*. 50 m, coarse sand, A. CROSNIER coll., 09.1958: 1 ♂ (MNHN-B 27216).

Madagascar. *Northwest coast*: Nosy Iranja. Sand, R. PLANTE coll., 26.08.1965: 1 ♀ (MNHN-B 27217). — Nosy Be. A. CROSNIER coll.: 1 ♂ (MNHN-B 27218).

Saya de Malha Bank. *"Sealark"* EXPEDITION: 101 m, , J.S. GARDINER coll., 6.09.1905: 1 ♀ (UMZ).

Maldives. *"Sealark"* EXPEDITION: *South Nilandu Atoll*, J.S. GARDINER coll.: 3 ♂, 5 ♀ (UMZ), 2 ♀ (UMZ), 1 ♀ (UMZ). — *Kolumadulu Atoll*, J.S. GARDINER coll.: 1 ♀ (UMZ). — *Haddumati Atoll*, J.S. GARDINER coll.: 1 ♀ (UMZ), 1 ♀ (UMZ), 1 ♀ (UMZ), 1 ♀ (UMZ), 1 ♀ (UMZ). — *Suvadiva Atoll*, J.S. GARDINER coll.: 1 ♂, 6 ♀ (UMZ), 2 ♂, 1 ♀ (UMZ), 2 ♀ (UMZ), 1 ♀ (UMZ).

Sri Lanka. Trincomalee, 11 m, K. FRISTEDT coll., 03. 1889: 1 ♂, 1 ♀ (MZUF C.2481).

Malaysia. Tioman Island: Tekek Bay, 26.06.1985: 1 ♀ (ZRC 1989.3765).

Singapore. Senang Island: 1 ♀ (ZRC 1965.8.2.235).

Japan. *Ogasawara Islands*. Muko-jima Island, 27°48.52'N, 142°02.62'E, 98-99 m, T. KOMAI coll., 15.10.1997: 1 ♀ (CBM-ZC 2004).

Philippine Islands. MUSORSTOM 3: stn CP 142, 11°47'S, 123°02'E, 26-27 m, 6.06.1985: 1 ♀ (MNHN-B 27215).

Indonesia. *Celebes Sea. "Challenger"*: stn 212, 06°54'N, 122°18'E, 18 m: 1 ♀ (BMNH 1884.31).

Moluccas, Ternate. W. KÜKENTHAL coll., 1894: 3 ♀ (SMF 4713).

Kai Islands. DANISH EXPEDITION TO KAI ISLANDS: stn 26, 05°38'S, 132°55'E, sand, 90 m, 14.04.1922: 1 ♂ (ZMUC).

Papua New Guinea. *Bismark Archipelago*. New Britain Island, Ralum, 24-30 m, S. DAHL coll., 24.11.1897: 1 ♀ (ZMB 18139).

Australia. *Great Barrier Reef*. Sir Charles Hardy Island, 20 m, coarse sand, J.B. JUKES coll., 08.1844: 1 ♀ holotype of *Cymopolia jukesii* White, 1847 9.0 x 10.9 mm (BMNH 46.80).

Torres Strait. Murray Island, A.C. HADDON coll., 1888: 1 ♂ (BMNH 1954.9.14.91).

Chesterfield Islands - Chesterfield-Bellona Plateau. CHALCAL 1: stn D 52, 21°13.40'S, 158°49.20'E, 69 m, 07.1984, 1 ♂ (MNHN-B 27219). — Stn D 55, 21°23.90'S, 158°59.60'E, 55 m, *Halimeda* and foraminiferans, 07.1984: 1 ♀ (MNHN-B 27220).

Stn 4 DE, 21°19.0'S, 158°48.0'E, 66 m, 19.10.1985: 1 ♀ (MNHN-B 27179).

CORAIL 2: stn DW 61, 19°14.96'S, 158°53.60'E, 54 m, *Halimeda* sand, 24.08.1988: 1 ♂, 1 ♀ (MNHN-B 27221). — Stn DW 73, 19°12.11'S, 158°22.57'E, 41 m, coarse sand, 25.08.1988: 1 ♀ (MNHN-B 27222). — Stn DW 76, 19°12.25'S, 158°32.90'E, 41 m, coarse sand and *Halimeda*, 25.08.1988: 1 ♀ (MNHN-B 27226). — Stn DW 87, 19°06.14'S, 158°59.94'E, 31 m, coarse sand and *Halimeda*, 26.08.1988, 1 ♀ (MNHN-B 27223). — Stn CP 98, 19°04.32'S, 158°31.66'E, 44-48 m, corals, 26.08.1988: 1 ♀ (MNHN-B 27224). — Stn DW 135, 19°31.37'S, 158°19.14'E, 46 m, coarse sand, 30.08.1988: 1 ♂, 1 ♀ (MNHN-B 27182). — Stn DW 137, 19°34.00'S, 158°14.60'E, 32 m, coarse sand, 30.08.1988: 1 ♀ (MNHN-B 27225).

New Caledonia. LAGON: stn 517, 19°08.9'S, 163°35.0'E, 42 m, *Halimeda* sand, 5.03.1985: 1 ♀ (MNHN-B 27210). — Stn 528, 19°31.2'S, 163°30.0'E, 47 m, fine sand, 6.03.1985: 1 ♂ (MNHN-B 27195). — Stn 536, 19°08.8'S,

Source : MNHN, Paris

163°22.6'E, 61 m, shelly sand, 6.03.1985: 1 ♀ (MNHN-B 27200). — Stn 541, 19°06.0'S, 163°13.3'E, 48-43 m, foraminiferan sand, 6.03.1985: 1 ♀ (MNHN-B 27211). — Stn 560, 22°43.2'S, 166°56.8'E, 48 m, shelly sand, 16.07.1985: 1 ♂ (MNHN-B 27181). — Stn 598, 22°19.1'S, 167°06.7'E, 73-75 m, shelly sand, 5.09.1986: 1 ♀ (MNHN-B 27227). — Stn 620, 22°02.4'S, 166°56.2'E, 50-52 m, *Halimeda*, 6.08.1986: 1 ♂ (MNHN-B 27228). — Stn 626, 21°57.9'S, 166°52.5'E, 47-48 m, foraminiferan sand, 6.08.1986: 3 ♂, 1 ♀ (MNHN-B 27229). — Stn 627, 21°58.9'S, 166°50.7'E, 45-47 m, *Halimeda* sand, 6.08.1986: 1 ♂ (MNHN-B 27205). — Stn 632, 21°57'3S, 166°49.6'E, 44-45 m, foraminiferan sand, 6.08.1986: 1 ♂ (MNHN-B 27201). — Stn 633, 21°55.6'S, 166°48.2'E, 50 m, foraminiferan sand and *Halimeda*, 6.08.1986: 1 ♂ (MNHN-B 27230). — Stn 641, 21°53.0'S, 166°43.0'E, 50-52 m, *Halimeda*, 7.08.1986: 1 ♂ (MNHN-B 27231). — Stn 682, 21°33.7'S, 166°18.6'E, 36-37 m, foraminiferan sand, 9.08.1986: 1 ♀ (MNHN-B 27190). — Stn 697, 21°27.6'S, 166°10.0'E, 35-36 m, foraminiferan sand, 10.08.1986: 1 ♂, 2 ♀ (MNHN-B 27196), 1 ♂ (MNHN-B 27191). — Stn 702, 21°26.7'S, 166°08.2'E, 37 m, foraminiferan sand, 10.08.1986: 1 ♂ 6.0 x 7.1 mm (MNHN-B 26814). — Stn 708, 21°23.6'S, 166°05.2'E, 34-35 m, foraminiferan sand, 10.08.1986: 1 ♂, 4 ♀ (MNHN-B 27232). — Stn 709, 21°22.2'S, 166°03.5'E, 39-40 m, foraminiferan sand, 10.08.1986: 3 ♂, 4 ♀ (MNHN-B 27233). — Stn 713, 21°22.6'S, 166°00.7'E, 34-35 m, coarse sand, 11.08.1986: 1 ♂, 1 ♀ 8.1 x 9.6 mm (MNHN-B 26996). — Stn 714, 21°21.0'S, 166°01.8'E, 37-38 m, coarse sand, 11.08.1986: 1 ♂ 7.7 x 9.2 mm (MNHN-B 26790). — Stn 724, 21°19.7'S, 165°57.8'E, 36-38 m, foraminiferan sand and *Halimeda*, 12.08.1986: 1 ♀ (MNHN-B 27212). — Stn 725, 21°18.6'S, 165°56.0'E, 41-43 m, coarse sand, 12.09.1986: 1 ♂ (MNHN-B 27206). — Stn 730, 21°17.2'S, 165°54.5'E, 40-43 m, coarse sand, 12.08.1986: 1 ♂, 1 ♀ (MNHN-B 27192). — Stn 747, 21°14.7'S, 165°50.9'E, 31-34 m, foraminiferan sand and *Halimeda*, 6.01.1987: 2 ♂ (MNHN-B 27234). — Stn 753, 21°14.9'S, 165°48.4'E, 53 m, shell debris, 7.01.1987: 1 ♀ (MNHN-B 27213). — Stn 754, 21°13.1'S, 165°49.2'E, 36 m, foraminiferan sand and *Halimeda*, 7.01.1987: 1 ♂, 2 ♀ (MNHN-B 27186). — Stn 761, 21°13.1'S, 165°44.3'E, 41-44 m, fine sand, 7.01.1987: 1 ♂ (MNHN-B 27202). — Stn 772, 21°07.7'S, 165°40.5'E, 30 m, coarse sand, 8.01.1987: 1 ♀ (MNHN-B 27203). — Stn 780, 21°06.0'S, 165°39.2'E, 33 m, coarse sand, 8.01.1987: 2 ♀ (MNHN-B 27193). — Stn 781, 21°04.6'S, 165°37.8'E, 36 m, coarse sand, 8.01.1987: 1 ♂, 1 ♀ (MNHN-B 27235). — Stn 788, 21°01.6'S, 165°34.7'E, 33 m, coarse sand, 9.01.1997: 1 ♀ (MNHN-B 27236). — Stn 794, 21°03.2'S, 165°30.9'E, 51 m, mud, 9.01.1987: 1 ♂, 4 ♀ (MNHN-B 27207). — Stn. 795, 21°01.6'S, 165°32.0'E, 31 m, coarse sand, 9.01.1987: 1 ♂ (MNHN-B 27184). — Stn 796, 20°59.9'S, 165°33.1'E, 38 m, coarse sand, 9.01.1987: 1 ♀ (MNHN-B 27185). — Stn 808, 20°57.4'S, 165°29.6'E, 30 m, coarse sand, 10.01.1987: 1 ♀ (MNHN-B 27237). — Stn 828, 21°50.1'S, 165°19.5'E, 28 m, coarse sand, 10.01.1987: 1 ♂ (MNHN-B 27188). — Stn 856, 20°36.9'S, 165°11.4'E, 30 m, coarse sand, 12.01.1987: 1 ♂ (MNHN-B 27204). — Stn 863, 20°39.4'S, 165°06.5'E, 28 m, coarse sand, 13.01.1987: 1 ♂ (MNHN-B 27241). — Stn 865, 20°38.7'S, 165°04.4'E, 24 m, shelly sand, 13.01.1987: 2 ♂, 1 ♀ (MNHN-B 27214); 1 ♀ (MNHN-B 27240). — Stn 866, 20°37.5'S, 165°02.7'E, 26 m, foraminiferan sand, 13.01.1987: 1 ♂ (MNHN-B 27197). — Stn 892, 20°18.3'S, 164°32.1'E, 26 m, coarse sand and *Halimeda*, 14.01.1987: 1 ♀ (MNHN-B 27238). — Stn 898, 21°13.6'S, 164°27.1'E, 22 m, gray sand, 14.01.1987: 1 ♂ (MNHN-B 27239). — Stn DW 1026, 20°04.6'S, 163°47.6'E, 29 m, foraminiferan sand and *Halimeda*, 3.04.1988: 1 ♀ (MNHN-B 27194). — Stn DW 1075, 19°52.0'S, 163°58.4'E, 28 m, white sand and *Halimeda*, 23.10.1989: 1 ♀ (MNHN-B 27242). — Stn DW 1094, 19°54.4'S, 163°41.2'E, 26 m, foraminiferan sand and *Halimeda*, 20.10.1989: 1 ♀ (MNHN-B 27243). — Stn DW 1097, 19°51.7'S, 163°42.5'E, 34 m, foraminiferan sand, 24.10.1989: 1 ♀ (MNHN-B 27198). — Stn DW 1110, 19°43.6'S, 163°41.8'E, 31 m, fine sand and foraminiferans, 25.10.1989: 1 ♀ (MNHN-B 27208). — Stn DW 1129, 19°29.2'S, 163°48.8'E, 40 m, shelly sand, 26.10.1989: 1 ♂ (MNHN-B 27244). — Stn DW 1134, 19°31.3'S, 163°34.6'E, 40 m, coarse sand and *Halimeda*, 26.10.1989: 1 ♂, 1 ♀ (MNHN-B 27187). — Stn DW 1155, 19°09.3'S, 163°15.9'E, 48 m, coarse sand, 30.10.1989: 1 ♂ (MNHN-B 27199). — Stn DW 1163, 19°11.3'S, 163°21.9'E, 48 m, fine sand, 30.10.1989: 2 ♂ (MNHN-B 27209). — Stn DW 1181, 19°23.9'S, 163°14.7'E, 45 m, coarse sand, 31.10.1989: 1 ♂, 1 ♀ (MNHN-B 27180). — Stn DW 1182, 19°27.3'S, 163°16.2'E, 48 m, coarse sand, 31.10.1989: 6 ♀ (MNHN-B 27183). — Stn DW 1192, 19°35.3'S, 163°24.6'E, 48 m, coarse sand, 1.11.1989: 2 ♂, 1 ♀ (MNHN-B 27189). — Stn DW 1197, 19°35.6'S, 163°22.1'E, 41 m, foraminiferans, 1.11.1989: 1 ♂ (MNHN-B 27245). — Stn DW 1205, 19°41.6'S, 163°25.6'E, 38 m, coarse sand, 2.11.1989: 1 ♀ (MNHN-B 27246). — Stn DW 1217, 19°51.6'S, 163°35.6'E, 30 m, coral debris, 3.11.1989: 1 ♂ (MNHN-B 27247).

TYPES. — *Holotype* of *Cymopolia jukesii* White, 1847: 1 ♀ 9.0 x 10.9 mm, Great Barrier Reef, Australia (BMNH 46.80).

Holotype of *Cymopolia carinipes* Paulson, 1875: 1 ♂ 6 x 7 mm (PAULSON, 1875), Red Sea. Material most probably lost.

TYPE LOCALITY. — Sir Charles Hardy Island, Great Barrier Reef, Australia, coarse sand, 20 m.

DIAGNOSIS. — Carapace (Figs 39b, 61c; CALMAN, 1900, pl. 1, fig. 9; RATHBUN, 1911, pl. 19, fig. 9; MOOSA & SERÈNE, 1981, pl. 2, fig. C) subquadrate, with large, low granules; anterolateral borders slightly curved, with widest extension at level of second and smallest of first two, truncate, anterolateral teeth; 2-3 shorter, smaller teeth may be found posterior to first two (HOLTHUIS, 1977, fig. 2a, as *Palicus carinipes*). Supraorbital borders each with

Source : MNHN, Paris

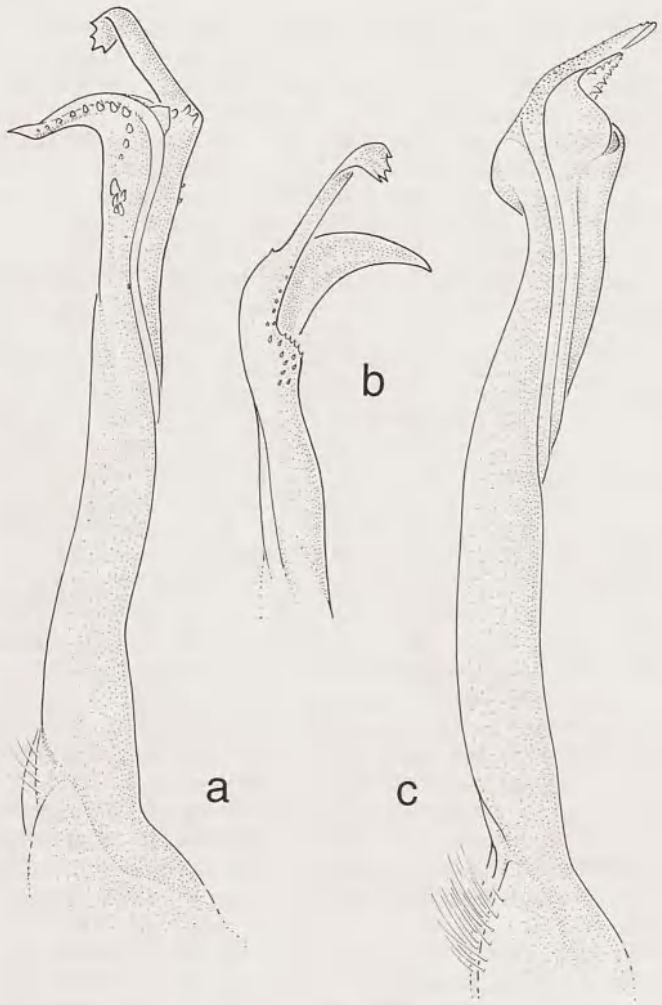


FIG. 41. — **a-b**, *Neopalicus contractus* (Rathbun, 1902): ♂ 10.8 x 12.0 mm, Chesterfield-Bellona Plateau, CHALCAL 1, stn D 56, 50 m (MNHN-B 26789): **a**, left male first pleopod, ventral view; **b**, left male first pleopod, distal part, lateral (outer side) view. — **c**, *Neopalicus jukesii* (White, 1847), ♂ 7.7 x 9.2 mm, east coast of New Caledonia, LAGON, stn 714, 37-38 m (MNHN-B 26790): left male first pleopod, ventral view.

one short, triangular lobe. Suborbital borders (Fig. 40b; CALMAN, 1900, pl. 1, fig. 10; HOLTHUIS, 1977, fig. 2b, as *Palicus carinipes*) each with two triangular, tooth-like lobes. Each basal antennal segment (Figs 40b-c) with two thin, nearly equal, wing-like ventral processes along ventral side (V-shaped in dorsal or ventral view). Dorsal borders of cheliped propodi with irregular, microscopic tubercles, increasing in size to form rows of conspicuous tubercles in large males; outer borders with hook-like setae; dense clusters of plumose setae on inner border of cheliped propodi in males (HOLTHUIS, 1977, fig. 2c, as *Palicus carinipes*). Dorsal and ventral sides and upper and lower borders of meri of second and third pairs of walking legs (P3-4) with rounded tubercles (CALMAN, 1900, pl. 1, fig. 12); anterior borders of carpi of P3-4 with similar tubercles; anterior borders of propodi with wide, convex enlargement. Abdomen of mature males narrow, with all segments distinct; one transverse ridge along each segment (slightly more salient and wider in segment 6). Telson of males and females with low, elongate, and rounded tubercles (CALMAN, 1900, pl 1, fig. 11). Male first pleopods (Fig. 41c; MOOSA & SERÈNE, 1981, fig. 7) with sinuous basal parts; each distal part with two pointed tips (close together in most specimens but separate in larger specimens; ZARENKOV, 1968, fig. 3E; HOLTHUIS, 1977, fig. 2e, as *Palicus carinipes*), dorsal with short teeth and ventral with small, blunt teeth. Abdomen of mature females with all segments distinct, one transverse ridge along each segment (less pronounced and curved in median portion in segment 6).

Color: A specimen from New Caledonia photographed live (Fig. 61c) had a broad orange-red, vertical band through the middle of the carapace, a black patch on each branchial region, and broad, orange-red bands across the walking legs.

DISCUSSION. — *N. jukesii* may be easily confused with *N. contractus*. Differences between the two species are summarized in Table 3. Although the lateral shape of the carapace (particularly by being broader at the level of the second anterolateral tooth in *N. jukesii* but at the level of the first anterolateral tooth in *N. contractus*) can be used as a diagnostic feature in most specimens, variations have been observed. In some specimens the first anterolateral tooth may be more salient than the second (although often on only one side of the carapace) or the broadest width of the carapace is at the level of the teeth posterior to the second anterolateral tooth (see HOLTHUIS, 1977, fig. 2a, as *Palicus carinipes*). The shape of each basal antennal segment (Figs 40b-c), V-shaped in dorsal or ventral view in contrast to a conspicuous, thick, dorsoventrally flattened process in *N. contractus* (Fig. 40a) is a useful diagnostic character.

Source : MNHN, Paris

TABLE 3. — Morphological differences between *Neopalicus contractus* (Rathbun, 1902) and *N. jukesii* (White, 1847).

	Neopalicus contractus (Rathbun, 1902)	***Neopalicus jukesii*** (White, 1847)
Carapace	Widest extension typically at level of first anterolateral tooth; anterlolateral borders straight, narrowing posteriorly; slightly narrower, more quadrate in appearance (CW/CL = 1.1)	Widest extension typically at level of second anterolateral tooth; anterolateral borders slightly curved, widening posteriorly; slightly wider, less quadrate in appearance (CW/CL= 1.2)
Posterolateral border of carapace	Shallow tubercles posterior to two obtuse anterolateral teeth	2-3 very shallow, obtuse teeth posterior to two obtuse anterolateral teeth
Frontal lobes of carapace	Slightly more pronounced (higher in middle), median sulcus wider and deeper	Slightly less pronounced (shallower in middle), median sulcus narrower and shallower
Supraorbital lobes	Two triangular lobes (outer shallow)	One shallow triangular lobe
Postorbital angle	Longer, slender; slightly higher than outer suborbital tooth	Shorter, blunt; as high as outer suborbital tooth
Basal antennal segment	Thick, dorsoventrally flattended, appearing as flat, nearly triangular process in ventral view; much shorter round process on inner border	Two flat, nearly equal processes (outer pointed, inner round), appearing V-shaped in dorsal or ventral view
Meri of P2-3	More pronounded, triangular tubercles along anterior (upper) and posterior (lower) borders	Fewer, less pronounded, round tubercles along anterior (upper) and posterior (lower) borders
Merus of P5	More pronounced tubercles along posterior (lower) border	Fewer, less pronounced tubercles along posterior (lower) border
Chelipeds of males	Inner border without a conspicuous cluster of setae	Inner border with a conspicuous cluster of setae, particularly larger specimens
Telson of males and females	Round, shallow granules	Round, shallow granules and 1-2 short, elongate, carina-like tubercles
First male pleopods	Two very different tips, one short with flatenned tip and second long and curved (Fig. 41a-b)	Two pointed tips that often appear as one (Fig. 40c)

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.0-1.1	1.6-1.8	1.5-1.8	0.7-0.8
Merus length/CL	0.3	0.5	0.4-0.5	0.2
Dactylus length/Cl	0.3-0.4	0.3-0.4	0.3	0.1-0.2

The fifth pair of pereopods (P5) (Fig. 39b; HOLTHUIS, 1977, fig. 2d, as *Palicus carinipes*) has, like in *N. contractus*, thick, tuberculate (except dactylus) segments, very thick spines along the posterior border of the propodus, and a slightly curved dactylus.

HOLTHUIS (1977) identified his Red Sea material as *Palicus carinipes* (Paulson, 1875), which is clearly a subjective junior synonym of *N. jukesii*. His conclusion was based on several differences, most important of which was the presence in his specimens of a curved ridge of tubercles (subhepatic crest) on the pterygostomial (subhepatic) region posterior to the suborbital margin (HOLTHUIS, 1977, fig. 2b). This ridge appears in the figure that accompanies the description of *P. carinipes* (PAULSON, 1875, pl. 9, fig. 4a; 1961, pl. 9, fig. 4a), while there is only a simple tubercle in the figure of *N. jukesii* given by CALMAN (1900, pl. 1, fig. 10) for *N. jukesii*. CALMAN's specimen (BMNH 1954.9.14.91) actually had a curved ridge on its pterygostomial region, even if it was stated that "the tubercle on the underside of the hepatic region ... represented [in *P. carinipes*] by a curved transverse ridge" was absent in the specimen (CALMAN, 1900: 31). A curved ridge of tubercles is present in both

Source : MNHN, Paris

N. jukesii (Fig. 40b) and *N. contractus* (Fig. 40a), a fact already mentioned by RATHBUN (1911: 240). It becomes more conspicuous with growth, however. A specimen (BMNH 1934.1.16.164) incorrectly identified by LAURIE (1906: 430, 431; pl. 1, fig. 12) as *Palicus jukesii* is actually *N. contractus*. LAURIE mentioned the characteristic curved ridge of tubercles but, to complicate matters, his figure shows only a short row.

HOLTHUIS (1977: 182, fig. 2b) mentioned that another difference between his Red Sea specimens and CALMAN's figure of *N. jukesii* (CALMAN, 1900, pl. 1, fig. 10) was an outer suborbital tooth described as "narrowly triangular" and a broader inner lobe in contrast to the opposite situation shown in CALMAN's figure. While most of the specimens examined in this study agreed with CALMAN's specimen, some did show the arrangement described by HOLTHUIS.

HOLTHUIS unfortunately referred to the fifth pereopod (P5) of his specimens as "subchelate" on account of the slightly curved dactylus (HOLTHUIS, 1977: 183). The same characteristic was attributed to *N. jukesii* based on the figure of the type by MIERS (1874, pl. 3, fig. 4) but not to the specimen of the same species as illustrated by CALMAN (1900, pl. 1, fig. 9). The dactylus, although curved, cannot articulate enough to make contact with the posterior border of the propodus and as such cannot be regarded as truly subchelate. As foreseen by HOLTHUIS himself, this and the other differences that were given have proven to be the result of individual differences and incorrect information.

The male first pleopods of *N. jukesii* were described as having a "spiraled shaft" by MOOSA & SERÈNE (1981: 44). The basal part of the pleopods should be described as sinuous, not spiraled (or helicoidal) as in the case of species of *Parapalicus*.

A female specimen from the Ogasawara Islands, Japan (8.0 x 8.8 mm; CBM-ZC 2004) is the first record of *Neopalicus* from Japan. It has slightly higher tubercles on the eye peduncles, two conspicuous rounded tubercles on the carpus of its only cheliped, unusually pointed postorbital angles similar to those of *N. contractus*, and the upper lobe of the meri of the third maxillipeds is larger and rounder that of *N. jukesii*. All other characters agree with *N. jukesii*. The examination of the male first pleopods would confirm if it is *N. jukesii* or if it belongs to a new species.

SIZE. — Maximum size among specimens examined: 13.8 x 15.1 mm (female, UMZ); 7.7 x 9.2 mm (male, MNHN-B 26790).

DISTRIBUTION. — *N. jukesii* is known from many records from a very wide geographic distribution (Fig. 49). It is known from the Red Sea (PAULSON, 1875, as *Cymopolia carinipes*; NOBILI, 1906a; ZARENKOV, 1971; HOLTHUIS, 1977, as *Palicus carinipes*); Amirante Islands and Saya de Malha Bank (RATHBUN, 1911); Maldives (ALCOCK, 1900; RATHBUN, 1902; BORRADAILE, 1903); Sri Lanka and Andaman Islands (ALCOCK, 1900); Myanmar (HENDERSON, 1893); Celebes Sea, Indonesia (MIERS, 1886); Ternate, Indonesia (DE MAN, 1902); Ceram, Kai, and Aru islands, Indonesia (MOOSA & SERÈNE, 1981); Torres Strait (WHITE, 1847b; MIERS, 1874; HASWELL, 1882; CALMAN, 1900); Queensland, Australia (HASWELL, 1882; WARD, 1942a). Its distribution is now extended to include the Gulf of Aden, Comoro Islands, Madagascar, Sri Lanka, Malaysia, Singapore, Japan, Philippine Islands, Bismark Archipelago, and the Coral Sea (Chesterfield Islands, Chesterfield-Bellona Plateau, and New Caledonia). It has been collected from the same Coral Sea stations together with *N. contractus* and the two species of *Palicoides*. Depth: 10 m (MIERS, 1886) to 146 m (RATHBUN, 1911).

Genus ***PALICOIDES*** Moosa & Serène, 1981

Palicoides Moosa & Serène, 1981: 45.

TYPE SPECIES. — *Cymopolia whitei* Miers, 1884 by original designation (MOOSA & SERÈNE, 1981). Gender masculine.

DIAGNOSIS. — Carapace subquadrate; frontal border divided into two large lobes that continue to supraorbital border as sinuous border without distinct notch. Anterolateral borders each with two large truncate teeth. Dorsal

Source : MNHN, Paris

surface of carapace with large, low granules and very low bosses. Thick, simple setae throughout carapace and surface of appendages. Eyes spherical; each peduncle with a conspicuous, crescent-shaped process on anterior border and hard, rounded tubercle on ventral side. Supraorbital borders each with 1-2 triangular lobes. Suborbital borders each with one triangular inner lobe, one broad, rectangular outer lobe. Segments 2-3 of antennae very wide and provided with numerous long setae; flagellum relatively short. Each basal antennal segment expanded into thick, flat process. Epistome expanded dorsoventrally, forming broad, semicircular, nearly flat surface; thin carina-like process across median portion with two rounded, tubercle-like central teeth. Chelipeds nearly equal in males and females, slender in females, heavier and very long in males. First three pairs of walking legs (P2-4) with flattened (not filiform) carpi, propodi, and dactyli. First pair (P2) shorter than second and third pairs (P3-4); third pair about as long as second pair. Meri of P2-4 elongate, borders with small, low tubercles except distalmost one. Anterior borders of propodi of P3-4 without wide, convex enlargement; posterior borders of dactyli entire. Fifth pair of pereopods (P5) reduced (0.8-0.9 CL), thick; rows of thick spines along posterior border of propodus. Abdomen of mature males elongate (sides almost parallel to each other), with all segments free or segments 4-6 fused, complete transverse ridge along segments 1-3 (two on fused segments 4-6). Male first pleopods long and slender; basal parts sinuous; each distal part biramous. Abdomen of mature females with segments 3-6 fused, one complete transverse ridge along segments 1-2 (varying number of complete or incomplete ridges on fused segments).

REDESCRIPTION. — Carapace subquadrate, slightly broader than long, with large, low granules and well defined, low bosses. Anterolateral borders straight, each with two truncate teeth followed by granular or tuberculate posterolateral border. Confluence of branchial and mesogastric regions depressed and smooth. Thoracic sternite 7 with reduced process (episternal process) at each outer edge and posterior to insertion of fifth pair of pereopods (P5), almost invisible dorsally. Posterior border of carapace smooth, without protruding tubercles. Thick, simple setae (sometimes dark in color) throughout carapace and appendages.

Frontal border divided into two rounded lobes, each continuing without distinct notch into folded border ending in sharp angle forming V-shaped fissure at supraorbital border. Supraorbital borders each with 1-2 triangular lobes. Postorbital angles long (extending just to anterior border of retracted eyes), pointed. Cornea of eyes spherical, almost as wide as base of peduncle; each peduncle with one conspicuous, thin, crescent-shaped process on anterior border, several soft or granular tubercles, and one hard, rounded tubercle on ventral side. Orbits deep.

Suborbital border with one small, triangular inner lobe, one broad, rectangular outer lobe. Pterygostomial process at each anterolateral angle of buccal frame projects ventrally, triangular or rounded edge.

Antennules short, thick, and transversely folded beneath front; interantennular septum narrow. Each basal antennal segment expanded into thick, dorsoventrally-flattened, scale-like process. Epistome expanded dorsoventrally, forming nearly flat surface between antennular fossae and anterior border of endostome; two rounded, tubercle-like central teeth on low, thin, carina-like process along median portion, flanked at same level by two very short outer lobes that connect with each pterygostomial lobe. Meri of third maxillipeds smaller and narrower than ischia.

Chelipeds equal or nearly equal in males and females, long and slender in females, very long (propodus and merus becoming greatly elongated, chelipeds slightly more unequal with increasing body size), slender in males. Fingers of chelipeds with cutting edge or triangular teeth (broadly rounded teeth in chelipeds of largest males), pollex becoming flatter with increasing size. Numerous simple and plumose setae along inner surfaces of cheliped propodi and fingers of males. First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair slightly shorter than second. First three pairs of walking legs (P2-4) with flattened carpi, propodi, and dactyli. Meri elongate; anterior (dorsal) and posterior (ventral) borders with small, unequal, low tubercles, rows of low tubercles on dorsal and ventral surfaces. Elongate (but not filiform and conspicuously slender) propodi and dactyli; posterior borders entire. Last two pairs of walking legs (P3-4) each with slightly broadened basis-ischia, having slightly flattened, thick-edged anterior and posterior borders. Anterior borders of propodus of P3-4 without conspicuously wide, convex enlargement. Fifth pair of pereopods (P5; Figs 42 a-b) reduced (0.8-0.9 CL), thick; basis-ischia and meri long and tuberculate; propodi with 2-3 rows of very thick spines along posterior border; dactyli thick and slightly curved.

Abdomen of mature males elongate, with both sides almost parallel to each other, with all segments free or segments 4-6 fused, segments 1-2 dorsoventrally compressed, one transverse ridge along each segment (incomplete

Source : MNHN, Paris

and very slight in segments 5-6) or only on segments 1-3 (plus two incomplete and very slight ridges along proximal portion of fused segment 4-6). Male first pleopods long and slender; basal parts sinuous; each distal part biramous. Second male pleopods short, thin, slightly curved; distal segment with blunt tip. Abdomen of immature males elongate, with varying number of fused segments.

Abdomen of mature females broad, rounded, with segments 3-6 fused, segments 1-2 dorsoventrally compressed, one complete transverse ridge along each segment 1-2 plus two along proximal portion of fused segment 3-6. Abdomen of immature females triangular (but broader than in males), segments 1-2 dorsoventrally compressed, 3-6 fused, complete transverse ridge along each segment 1-2 and one along proximal portion of fused segment 3-6.

SPECIES INCLUDED. — *P. longimanus* (Miyake, 1936) and *P. whitei* (Miers, 1884).

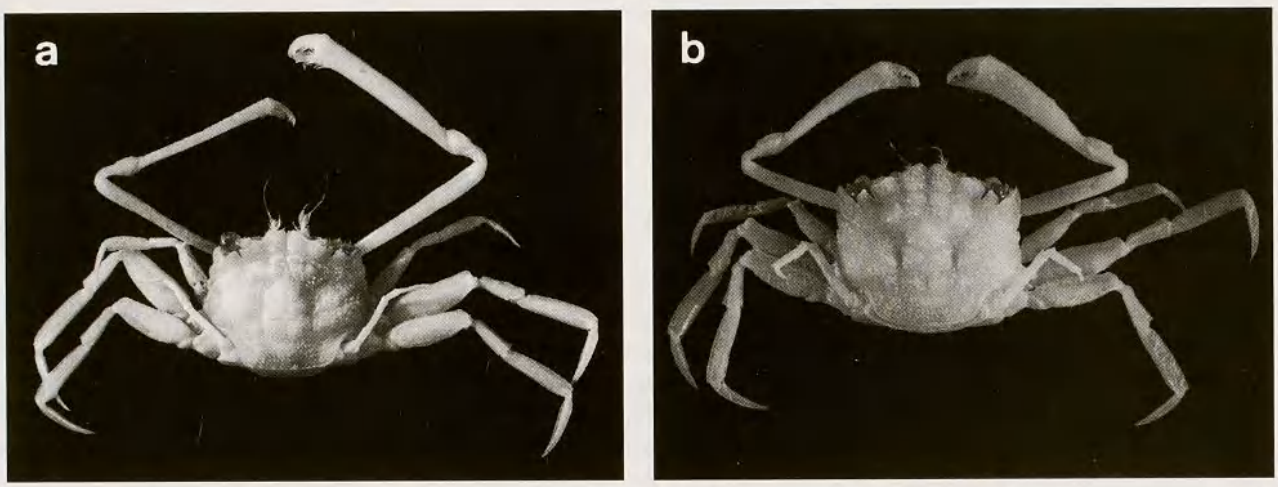


FIG. 42. — **a**, *Palicoides longimanus* (Miyake, 1936), ♂ 9.9 x 11.5 mm, north coast of New Caledonia, LAGON, stn 894, 12 m (MNHN-B 26997): dorsal view. — **b**, *Palicoides whitei* (Miers, 1884), ♂ 8.6 x 9.6 mm, Seychelles, REVES 2, stn 50, 45-50 m (MNHN-B 26798): dorsal view.

SEXUAL DIMORPHISM. — Females are generally larger in size than males. The chelipeds are equal or nearly equal in both sexes but they are much longer in males, increasing in length with body size. The lower surfaces of the cheliped meri and fingers of the males are provided with many long simple and plumose setae. They are particularly abundant and longer along the distal portion of the meri.

DISCUSSION. — Although close to *Neopalicus* in the morphology of the carapace, species of *Palicoides* can be easily differentiated by the conspicuous, crescent-shaped process on each eye peduncle. In contrast, the eye peduncles of *Neopalicus* have several tubercles but never a conspicuous process. There are also significant differences in the morphology of the basal antennal segment (see discussion of *Neopalicus*) and abdomen. Several segments are fused in *Palicoides* (4-6 in males of *P. longimanus*, 3-6 in females of both species), while none are fused in *Neopalicus*. Other differences are listed in Table 1. Another characteristic of *Palicoides* is the decrease in size of the upper borders of the meri of the third maxillipeds. It is reduced to a short, rounded or slightly pointed protuberance.

MOOSA & SERÈNE (1981) mention in the diagnosis of their new genus *Palicoides* that the male abdomen has "distinct segments" (MOOSA & SERÈNE, 1981: 45). Segments 4-6 are fused in *P. longimanus* and in smaller males of *P. whitei*. The fusion of segments in *P. longimanus*, however, is mentioned in their key to the species (MOOSA & SERÈNE, 1981: 46).

No described species of palicids from outside the Indo-west Pacific region resemble *Palicoides* in terms of the quadrate, relatively flat carapace, and thickened fifth pereopods. Since the same applies to *Neopalicus*, it appears that shallow-water, coarse-sediment habitats associated with coral reefs are occupied by palicids only in the Indo-west Pacific region.

Source : MNHN, Paris

Key to the species of the genus *PALICOIDES*

1. Two frontal lobes of carapace small, separated by narrow, shallow notch (Fig. 42a). Supraorbital border with only one triangular lobe ..... ***P. longimanus*** (Miyake, 1936)

— Two frontal lobes of carapace broad, separated by wide, deep notch (Fig. 42b). Supraorbital border with one triangular lobe and small, rounded to slightly pointed outer lobe .... ***P. whitei*** (Miers, 1884)

Palicoides longimanus (Miyake, 1936)

Figs 42a, 43a, 50, 61d

Cymopolia longimana Miyake, 1936: 495, fig. 1, pl. 35, figs 3-4. — SAKAI, 1939: 609, fig. 90c; 1956: 52.
Palicus longimanus - SERÈNE, 1968: 96. — SAKAI, 1976: 595, fig. 325c.
Palicoides longimanus - MOOSA & SERÈNE, 1981: 46, fig. 8, pl. 3, fig. A.
Palicus whitei - GARTH *et al.*, 1987: 259 [non *Palicoides whitei* (Miers, 1884)].

MATERIAL EXAMINED. — **Japan**. *Yaeyama Islands.* Iriomote Island, Sonai, Yaeyama Expedition, H. OHSHIMA coll., 08.1934: 1 ♂ holotype of *Cymopolia longimana* Miyake, 1936 9.4 x 10.9 mm (ZLKU 5771).

Indonesia. *Sulawesi.* Bahuluang Island, from beach sand, 10.10.1984: 1 ♂ (RMNH 47901).

Moluccas, Ambon. RUMPHIUS EXPEDITION 1: stn MO-1, 03°32'00"S, 128°12'30"E, KASIJAN coll., 8.01.1973: 1 ♀ (MNHN-B 10006).

RUMPHIUS EXPEDITION 2: seagrass meadow, R. SERÈNE coll. (CB 1261), 26.01.1975: 1 ♂ (MNHN-B 27270).

Chesterfield Islands. CORAIL 2: stn DW 41, 19°21.52'S, 158°31.87'E, 52 m, *Halimeda* sand, 23.07.1988: 1 ♂ (MNHN-B 27271). — Stn DW 59, 19°18.50'S, 158°56.55'E, 50 m, 24.08.1988: 1 ♀ (MNHN-B 27272). — Stn DW 73, 19°11.00'S, 158°22.57'E, 41 m, 25.08.1988: 1 ♀ (MNHN-B 27273). — Stn DW 87, 19°06.14'S, 158°59.94'E, 31 m, coarse sand and *Halimeda*, 28.08.1988: 1 ♀ (MNHN-B 27274). — Stn DW 154, 19°52.04'S, 158°26.5'E, 35 m, *Halimeda*, 1.09.1988: 1 ♀ (MNHN-B 27275). — Stn DW 160, 19°46.00'S, 158°23.00'E, 35-41 m, sand, 1.09.1988: 2 ♀ (MNHN-B 27276).

New Caledonia. LAGON: stn 1, 22°18.0'S, 166°24.6'E, 19 m, fine sand and *Halimeda*, 05.1984: 1 ♀ (MNHN-B 27248). — Stn 7, 22°24.0'S, 166°19.7'E, 14 m, white sand, 05.1984: 1 ♀ (MNHN-B 27249). — Stn 49, 22°18.5'S, 166°13.8'E, 10 m, sargassum, 05.1984: 1 ♀ (MNHN-B 27263). — Stn 50, 22°16.6'S, 166°12.2'E, 12 m, white sand, 05.1984: 2 ♀ (MNHN-B 27277). — Stn 52, 22°14'S, 166°14'E, 13 m, seagrasses, 1984: 1 ♂ (MNHN-B 27258). — Stn 69, 22°22.8'S, 166°31.7'E, 13 m, shelly sand, 08.1984: 1 ♀ 14.7 x 17.0 mm (MNHN-B 26791). — Stn 99, 22°32.6'S, 166°34.6'E, 14 m, corals, 08.1984: 1 ♀ (MNHN-B 27278). — Stn 180, 21°59.6'S, 166°04.5'E, 10 m, mud, 09.1984: 1 ♀ (MNHN-B 27279). — Stn 185, 22°04.8'S, 166°02.2'E, 15 m, coral blocks and *Halimeda*, 19.09.1984: 1 ♂ (MNHN-B 27253). — Stn 187, 22°02.8'S, 166°01.7'E, 13 m, shelly sand, 09.1984: 2 ♀ (MNHN-B 27259). — Stn 192, 22°00.6'S, 166°00.0'E, 18 m, boulders, 09.1984: 1 ♀ (MNHN-B 27264). — Stn 253, 22°22.1'S, 166°22.9'E, 16 m, coarse sand, 10.1984: 1 ♀ (MNHN-B 27280). — Stn 269, 22°18.0'S, 166°18.1'E, 20 m, muddy sand and *Halimeda*, 11.1984: 2 ♀ (MNHN-B 27250). — Stn 284, 22°25.8'S, 166°24.9'E, 6 m, corals, 10.1984: 1 ♀ (MNHN-B 27265). — Stn 455, 18°29.5'S, 163°07.9'E, 40 m, coarse sand, 28.02.1985: 1 ♀ (MNHN-B 27254). — Stn 483, 19°01.0'S, 163°32.2'E, 33 m, boulders and *Halimeda*, 2.03.1985: 1 ♀ (MNHN-B 27281). — Stn 550, 22°54.0'S, 166°57.5'E, 26 m, coral debris, 15.07.1985: 2 ♀ (MNHN-B 27282). — Stn 554, 22°50'S, 166°54'E, 27 m, white sand and shells, 16.07.1985: 1 ♂ (MNHN-B 27255). — Stn 623, 22°01.0'S, 166°50.5'E, 32-40 m, 6.08.1983: 1 ♀ (MNHN-B 27283). — Stn 890, 20°20.3'S, 164°35.6'E, 23 m, coarse sand, 14.01.1987: 1 ♂, 1 ♀ (MNHN-B 27260). — Stn 891, 20°19.8'S, 164°33.5'E, 25 m, mud and shells, 14.01.1987: 1 ♀ (MNHN-B 27284). — Stn 892, 20°18.3'S, 164°32.1'E, 26 m, coarse sand and *Halimeda*, 14.01.1987: 1 ♂, 1 ♀ (MNHN-B 27285). — Stn 894, 20°16.6'S, 164°28.0'E, 12 m, coarse sand and *Halimeda*, 14.01.1987: 1 ♂ 9.9 x 11.5 mm (MNHN-B 26997). — Stn DW 896, 20°15.2'S, 164°29.3'E, 20 m, medium-size sand and mud, 14.01.1987: 1 ♂ (MNHN-B 27251). — Stn 898 20°13.6'S, 164°27.1'E, 22 m, gray sand, 14.01.1987: 1 ♀ (MNHN-B 27267). — Stn 899, 20°14.2'S, 164°25.2'E, 16 m, coarse sand and *Halimeda*, 14.01.1987: 1 ♀ (MNHN-B 27286). — Stn DW 921, 20°51.2'S, 164°26.6'E, 10-11 m, shelly sand, 27.04.1988: 1 ♀ (MNHN-B 27287). — Stn DW 934, 20°43.0'S, 164°16.8'E, 10 m, coarse sand and *Halimeda*, 27.04.1988: 1 ♀ (MNHN-B 27269). — Stn DW 944, 20°35.2'S, 164°11.9'E, 14-15 m, shelly sand, 28.04.1988, 1 ♀ (MNHN-B 27288). — Stn DW 948, 20°32.2'S, 164°08.8'E, 16 m, coarse sand and *Halimeda*, 28.04.1988: 2 ♀ (MNHN-B 27256). — Stn DW 952, 20°30.8'S, 164°07.4'E, 16-17 m, coarse sand, 28.04.1988: 1 ♂ 9.6 x 11.2 mm (MNHN-B 26794). — Stn DW 953, 20°31.8'S, 164°05.8'E, 18-19 m, white sand, 28.04.1988: 1 ♂ (MNHN-B 27261). — Stn DW 954, 20°31.0'S, 164°03.0'E, 15-17 m,

Source : MNHN, Paris

coarse sand, 20.04.1988: 1 ♂, 1 ♀ (MNHN-B 27289). — Stn 985, 20°20.3'S, 163°57.9'E, 15-17 m, coarse sand and *Halimeda*, 30.04.1988: 1 ♀ (MNHN-B 27257). — Stn DW 989, 20°18.1'S, 163°57.1'E, 21 m, foraminiferan sand, 30.04.1988: 1 ♀ (MNHN-B 27290). — Stn DW 1008, 20°11.0'S, 163°53.4'E, 27 m, shells and foraminiferans, 2.05.1988: 1 ♀ (MNHN-B 27262). — Stn DW 1046, 20°05.0'S, 164°06.6'E, 6-7 m, boulders and *Halimeda*, 4.05.1988: 1 ♂, 1 ♀ (MNHN-B 27291). — Stn DW 1075, 19°52.0'S, 163°58.4'E, 28 m, white sand and *Halimeda*, 23.10.1989: 1 ♀ (MNHN-B 27268). — Stn DW 1094, 19°54.4'S, 163°41.2'E, 26 m, foraminiferan sand and *Halimeda*, 24.10.1989: 1 ♂ (MNHN-B 27292). — Stn DW 1163, 19°11.3'S, 163°21.9'E, 48 m, fine sand, 30.10.1989: 1 ♀ (MNHN-B 27213). — Stn DW 1168, 19°15.9'S, 163°09.3'E, 50 m, coarse sand, 30.10.1989: 1 ♀ (MNHN-B 27294). — Stn DW 1181, 19°23.9'S, 163°14.7'E, 45 m, coarse sand, 31.10.1989: 1 ♂, 1 ♀ (MNHN-B 27295). — Stn DW 1182, 19°27.3'S, 163°16.2'E, 48 m, coarse sand, 30.10.1989: 1 ♂, 1 ♀ (MNHN-B 27296). — Stn DW 1205, 19°41.6'S, 163°25.6'E, 38 m, coarse sand, 2.11.1989: 1 ♂ 6.2 x 6.8 mm (MNHN-B 26793). — Stn DW 1210, 19°45.5'S, 163°35'E, 31 m, 3.11.1989: 1 ♂ (MNHN-B 27252).

Passe de Boulari: 15 m, 20.03.1988: 1 ♂ 11.4 x 12.5 mm (MNHN-B 26792). — *Îlot Goeland*: 10 m, 16.04.1993: 1 ♂ (MNHN-B 27297). — *Îlot Maître*: 6 m, seagrass meadow, suction pump, P. BOUCHET coll., 24.03.1993: 1 ♀ (MNHN-B 27300). — *Bancs de l'Ouest*: 1 ♂ (MNHN-B 27298). — *Récif Aboré*: 10 m, P. BOUCHET coll., 8.10.1992: 1 ♀ (MNHN-B 27299).

Loyalty Islands. MUSORSTOM 6: stn DW 434, 20°21.21'S, 166°08.64'E, 23 m, 18.02.1989: 1 ♂ (MNHN-B 27266).

Marshall Islands. *Enewetak Atoll*: stn 429, J.W. KNUDSEN coll., 15.08.1967: 1 ♀ (LACM). — Stn 431, 16.08.1967: 2 ♀ (LACM). — Stn 183: 2 ♂, 1 ♀ (LACM). — Stn 184: 1 ♂ (LACM). — Stn 187: 1 juv., ♂, 1 ♀ (LACM). — Stn 189: 1 juv. ♂ (LACM). — Stn 722: 1 ♂ (LACM).

TYPES. — *Holotype* of *Cymopolia longimana* Miyake, 1936: 1 ♂ 9.4 x 10.9 mm, Ryukyu Islands, Japan (ZLKU 5771).

TYPE LOCALITY. — Sonai, Iriomote Island, Yaeyama Islands, Ryukyu Islands, Japan.

DIAGNOSIS. — Carapace (Figs 42a, 61d; MIYAKE, 1936, pl. 35, fig. 3; MOOSA & SERÈNE, 1981, pl. 3, fig. A) subquadrate, with large, low granules. Frontal border with two small lobes separated by narrow, shallow notch. Two truncate anterolateral teeth. Supraorbital borders each with one triangular lobe. Each eye peduncle with rounded, low, soft tubercle at distal end. Postorbital angles triangular, with rounded tips. Suborbital borders each with one rounded to triangular inner lobe and one broad, rounded outer lobe (MIYAKE, 1936, fig 1A). Segments 2-3 of antennae very wide, thick, numerous long setae. Each basal antennal segment expanded into thick, dorsoventrally-flattened process. Chelipeds with long carpi and meri in larger specimens of both sexes but extremely long and increasingly (but slightly) unequal in males (Fig 42a; MIYAKE, 1936, pl. 35, figs 3-4); dorsal borders of propodi with irregular, microscopic tubercles; outer border with hook-like setae; long, simple and plumose setae along lower borders of cheliped propodi and fingers in males. Upper and lower borders of meri and anterior borders of carpi of second and third pairs of walking legs (P3-4) with very small, low tubercles; meri of P2 elongate, equal or longer than half carapace length (0.5-0.6 CL). Abdomen of mature males narrow, with segments 4-6 fused; one complete transverse ridge along segments 1-3, low ridges on proximal portion of fused segment 4-6. Male first pleopods (Fig. 43a; MIYAKE, 1936, figs 1D, F; MOOSA & SERÈNE, 1981, fig. 8) with sinuous basal parts; each distal part spherical, with two pointed ventral teeth and long, toothed dorsal process. Abdomen of mature females with segments 3-6 fused, one transverse ridge along each segment 1-2, two complete ridges along proximal portion of fused segment 3-6.

Color: A male from New Caledonia photographed live (Fig. 61d) had a broad, vertical, red-brown band through the middle of the carapace, irregular black patches along the sides of the carapace, and thin red-brown bands across the walking legs. The chelipeds were red-brown. A female from the same area had a similar color pattern except that the band across the carapace was solid red-brown. Many preserved specimens of both sexes had a dark dot on the median portions of the dactyli of the chelipeds and fifth pereopods (P5).

DISCUSSION. — The single male specimen that was used in the description of *P. longimanus* (MIYAKE, 1936, pl. 35) was characterized by very long and slender chelipeds, hence the name of the species. MOOSA & SERÈNE (1981), who examined only three specimens (one male and two females, all of a relatively large size), concluded that the chelipeds were always very long in both sexes. They used the relative length of the chelipeds to

Source : MNHN, Paris

distinguish between *P. longimanus* and the two other species they included in the new genus *Palicoides*, *P. whitei* and *P. ternatensis* Moosa & Serène, 1981, a subjective junior synonym of *P. whitei* (see below).

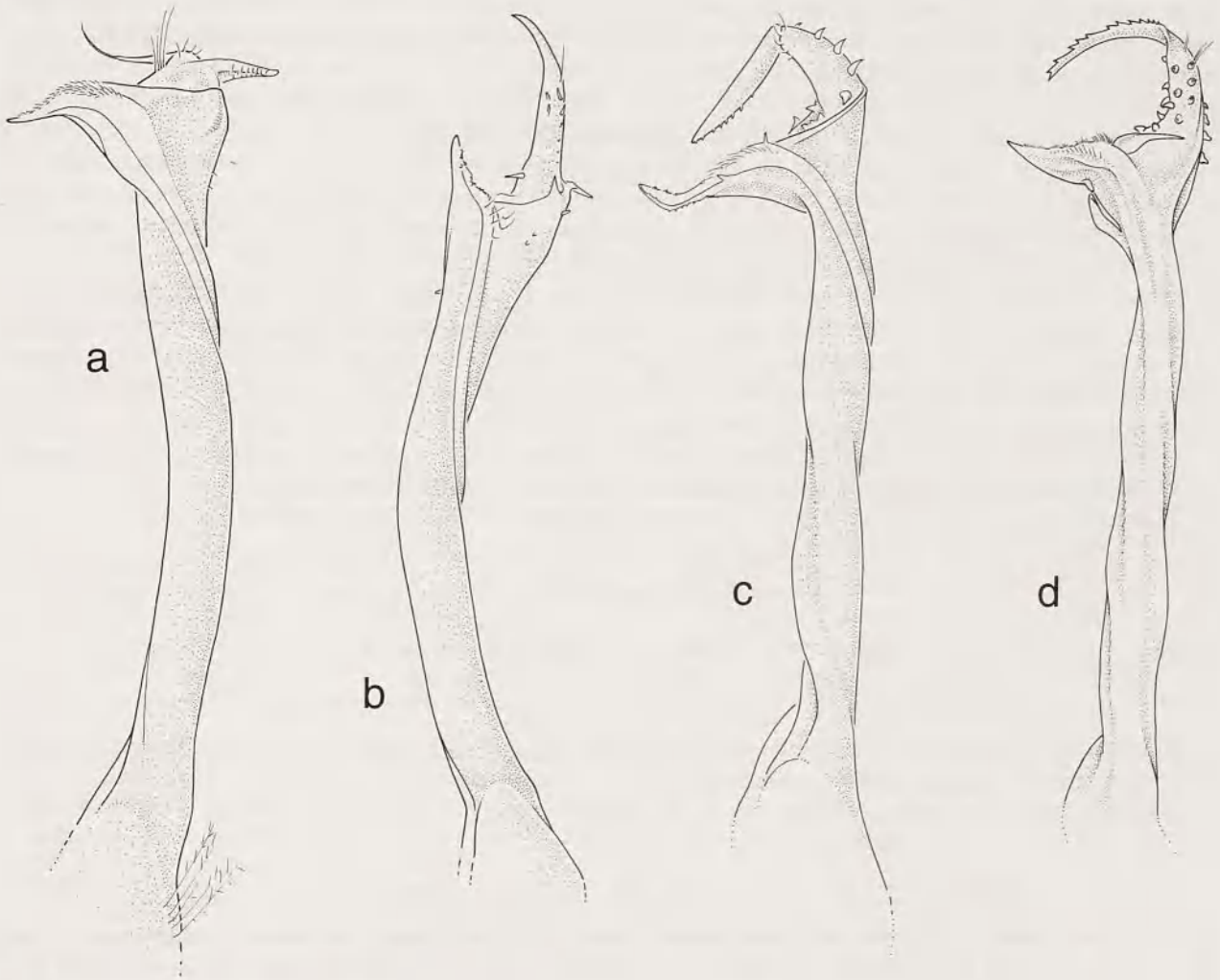


FIG. 43. — **a**, *Palicoides longimanus* (Miyake, 1936), ♂ 11.4 x 12.5 mm, Passe de Boulari, New Caledonia, 15 m (MNHN-B 26792): left male first pleopod, ventral view. — **b-d**, *Palicoides whitei* (Miers, 1884): **b**, ♂ 5.1 x 5.0 mm, LAGON, Grand Récif, New Caledonia, stn 1094, 26 m (MNHN-B 26795): left male first pleopod (ventral view) of immature specimen. — **c**, ♂ 8.2 x 9.7 mm, west coast of New Caledonia, LAGON, stn 815, 32 m (MNHN-B 26800): left male first pleopod (ventral view) of intermediate-size specimen. — **d**, ♂ CL 14.5 mm, LAGON, west coast of New Caledonia, stn 748, 35 m (MNHN-B 26801): left male first pleopod (ventral view) of large-size specimen.

Examination of a large number of specimens of *P. longimanus* and *P. whitei* has shown that very long chelipeds (total length far exceeding carapace length) are found in large individuals of both species (Figs 42a-b, 61e). The relative length of the chelipeds increases with body size in both sexes. A direct relationship between cheliped length and body size is not always observed, however, perhaps the result of some chelipeds being regenerated (Fig. 61d). In *P. longimanus*, male chelipeds become longer than carapace length at a carapace length of approximately 9.0 mm, reaching 2.2 times carapace length (cheliped meri 0.9 times carapace length) in the largest male examined, 11.4 x 12.5 mm (MNHN-B 26792). Female chelipeds reach a length equal to carapace length at a carapace length of approximately 11.0 mm but they never exceeded carapace length in any of the females that were examined. The meri of male chelipeds were never found to be longer than carapace length, as

Source : MNHN, Paris

stated in the key of MOOSA & SERÈNE (1981: 45). They also referred to only two fused segments (5-6) in the only *P. longimanus* male they examined (MOOSA & SERÈNE, 1981: 52). Adult males were actually found to have segments 4-6 fused.

The specimens examined in this study agree with the description of the species (MIYAKE, 1936) in most aspects. No mention was made in the description of the crescent-shaped process on the eye peduncles, a diagnostic characteristic of the genus, although it is present in the holotype (ZLKU 5771). The tip of the process on the left peduncle, however, is severed. A small but not crescent-shaped process is shown in two figures (MIYAKE, 1936, figs 1 A-B), one of which is reproduced by SAKAI (1939, fig. 90c; 1987, fig. 325c). The figure of the anterolateral portion of the carapace (MIYAKE, 1936, fig. 1B) does not show the gap between the first anterolateral tooth and the postorbital angles. The gap was found in the holotype and in most but not all of the specimens that were examined. Another diagnostic character present in the holotype but not mentioned in the description or shown in MIYAKE's figures is the presence of long setae along the lower borders of the chelipeds.

MOOSA & SERÈNE (1981: 45) described the male first pleopods as having a "spiraled shaft". It is best described as sinuous, but not spiral (or helicoidal) as in the basal parts of *Parapalicus*. The male first pleopods of the smallest male examined in this study (6.2 x 6.8 mm; MNHN-B 26793) consisted of two flat terminal processes similar to the male first pleopods in small males of *P. whitei* (see below). Unlike *P. whitei*, however, two minute spines were present on opposite sides at the base of the processes.

Some variation was observed in the shape of the basal antennal segment. It was elongate or even biramous in a few specimens but thick and dorsoventrally-flattened in the great majority of specimens that were examined.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.1-1.2	1.7-2.1	1.8-2.0	0.8-0.9
Merus length/CL	0.4	0.5-0.6	0.5-0.6	0.3
Dactylus length/Cl	0.3	0.4-0.5	0.4-0.5	0.1-0.2

P. longimanus may be easily confused with *P. whitei*, its only congener. Differences between species are given in Table 4. In many specimens of *P. longimanus* there is only a very narrow fissure between the first anterolateral teeth and the postorbital angles, whereas it is wider in many specimens of *P. whitei* (MOOSA & SERÈNE, 1981, fig. 10). This, however, is not an absolute character.

TABLE 4. — Morphological differences between *Palicoides longimanus* (Miyake, 1936) and *P. whitei* (Miers, 1884).

	Palicoides longimanus (Miyake, 1936)	***Palicoides whitei*** (Miers, 1884)
Frontal lobes of carapace	Two small lobes separated by narrow and shallow notch	Two broad lobes separated by wider, deeper notch
Distalmost tubercle on eye peduncle	Round, shallow	Pointed, reaching almost same heigth of crescent-shaped process
Supraorbital borders	One triangular lobe	One triangular inner lobe and small, round to sligthly pointed outer lobe
Suborbital borders	Round to triangular inner lobe and broad, round outer lobe	Two rectangular to slightly round lobes
Abdomen of mature males	Segments 4-6 fused	Complete segments
First male pleopods	Two ventral teeth, long toothed dorsal process (Fig. 43a)	Small males: two flatenned processes (Fig. 43b); medium-size males: bent toothed tip (Fig. 43c); larger males: arched process with thick teeth (Fig. 43d)

SIZE. — Maximum size among specimens examined: 14.7 x 17.0 mm (female, MNHN-B 26791); 11.4 x 12.5 mm (male, MNHN-B 26792).

Source : MNHN, Paris

DISTRIBUTION. — Previously known only from the Ryukyu Islands, Japan (MIYAKE, 1936; SAKAI, 1956) and Kai (Banda Sea) and Tanimbar (Arafura Sea) islands, Indonesia (MOOSA & SERÈNE, 1981). It is now also known from Ambon (Indonesia), the Coral Sea (Chesterfield Islands, New Caledonia, and the Loyalty Islands), and the Marshall Islands (Fig. 50). It has been collected from the same Coral Sea stations together with *Neopalicus jukesii* and *P. whitei*. Depth: 6 m to 57 m (MOOSA & SERÈNE, 1981).

Palicoides whitei (Miers, 1884)

Figs 42b, 43b-d, 50, 61e

Cymopolia whitei Miers, 1884: 551, pl. 49, figs C, c. — GUINOT, 1967: 280.
Palicus whitei - BOUVIER, 1897: 65. — ALCOCK, 1900: 453. — CALMAN, 1900: 31, pl. 2, figs 14-19. — RATHBUN, 1911: 240, pl. 19, fig. 10. — LAURIE, 1915: 416, 421, 473. — MCNEILL, 1968: 82. — SERÈNE, 1968: 96.
Palicoides whitei - MOOSA & SERÈNE, 1981: 46, figs 9-10.
Palicoides ternatensis Moosa & Serène, 1981: 50, fig. 11, pl. 3, fig. B.

MATERIAL EXAMINED. — **Socotra**. Stn 146, 12°37.1'N, 54°18.3'E, 20-25 m, sand, under coral *Goniopora stokesii*, M. APEL coll., 2.04.1999: 1 ♂ (SMF 25280).

Seychelles. *"Alert"*: stn 194, 7-22 m, COPPINGER coll., 03.1882: 1 ♂ lectotype of *Cymopolia whitei* Miers, 1884 6.0 x 6.7 mm, 1 ♂ paralectotype 5.8 x 6.5 mm, 2 ♀ paralectotypes 8.4 x 9.4 mm, 7.5 x 8.4 mm (BMNH 1882.24).

REVES 2: stn 41, 04°44.0'S, 56°15.1'E, 50 m, shelly sand and *Halimeda*, 13.09.1980: 1 ♀ (MNHN-B 27303). — Stn 47, 04°03.8'S, 55°59.5'E, 45-55 m, shelly sand, 14.09.1980: 2 ♂ (MNHN-B 27310). — Stn 50, 03°56.1'S, 55°40.5'E, 45-50 m, shelly sand, 15.09.1980: 1 ♂ (MNHN-B 27304), 1 ♂ 8.6 x 9.6 mm (MNHN-B 26798).

Mauritius. Tombeau Bay, stn 38, 73 m, T. MORTENSEN coll., 8.10.1929: 1 ♂ (ZMUC).

Madagascar. *Nosy Be*. A. CROSNIER coll.: 1 ♂ (MNHN-B 27317).

Comoro Islands. *Mayotte*. Lagoon, medium-size sand, 55 m, A. CROSNIER coll., 09.1958: 1 ♀ (MNHN).

Japan. *Ryukyu Islands*. Okinawa, 26°30.4'N, 127°52.6'E, 48.8 m, R.F. BOLLAND coll., 12.06.1984: 1 ♂ (USNM). — 26°30.0'N, 127°50.9'E, 64 m, R.F. BOLLAND coll., 29.06.1984: 1 ♂ (USNM), 1 ♀ (USNM). — Kerama Islands, Amuro-jima Island, *"Toyoshio-maru"*, stn 7, 26°10.00'N, 127°18.90'E, 52 m, T. KOMAI coll., 19.05.1998: 1 ♂ (CBM-ZC 4671).

Indonesia. *Halmahera*. MARIEL KING MEMORIAL EXPEDITION: stn HD I/1, Dodinga Bay, 0°49'N, 127°33'E, 31-42 m, coral (*Acropora*) sediment and mud, 20.05.1970: 1 ♂ holotype of *Palicoides ternatensis* Moosa & Serène, 1981 10.5 x 12.3 mm (RDC CB 2724).

Saparua Island. RUMPHIUS EXPEDITION 1: stn Ip3, 03°30'15"S, 128°41'20"E, KASIJAN coll., 18.01.1973: 1 ♂ (MNHN-B 10005).

Australia. *Torres Strait*. Murray Island, A.C. HADDON coll., 1888: 2 ♀ (BMNH 1954.9.14.89-90).

Queensland. GREAT BARRIER REEF EXPEDITION: stn 16, off Lookout Point, 9.03,1929: 1 ♂, 1 ♀. — Stn 17, off Lookout Point, 9.03.1929: 3 ♀ (BMNH 1950.12.1.24-27).

Chesterfield Islands, **Chesterfield-Bellona Plateau**. CHALCAL 1: stn DC 34, 19°52.10'S, 158°20.10'E, 33-37 m, *Halimeda* sand, 21.07.1984: 1 ♂ (MNHN-B 27343). — Stn DC 45, 20°48.93'S, 158°30.21'E, 50 m, 23.07.1984: 1 ♂, 2 ♀ (MNHN-B 27346). — Stn CP 14, 21°13.50'S, 158°50.20'E, 66 m, 24.07.1984: 1 ♀ (MNHN-B 27347). — Stn DC 53, 21°19.50'S, 158°55.30'E, 60 m, 24.07.1984: 1 ♀ 20.5 x 23.5 mm (MNHN-B 26799), 1 ♂ (MNHN-B 27351). — Stn DC 55, 21°23.90'S, 158°59.60'E, 55 m, *Halimeda* and foraminiferans, 25.07.1984: 3 ♀ (MNHN-B 27348).

"Vauban": stn 7 DE, 21°21.0'S, 158°52.7'E, 56-58 m, 19.10.1985: 1 ♂, 1 ♀ (MNHN-B 27349). — Stn 14 DE, 21°46.5'S, 159°28.3'E, 42-52 m, 22.10.1985: 1 ♀ (MNHN-B 27350).

CORAIL 2: stn DW 41, 19°21.52'S, 158°31.87'E, 52 m, *Halimeda*, 23.07.1988: 1 juv. (MNHN-B 27352). — Stn DW 59, 19°18.50'S, 158°56.55'E, 50 m, 24.08.1988: 1 ♀ (MNHN-B 27354). — Stn DW 67, 19°14.9'S, 158°36.94'E, 66 m, 24.08.1988: 1 ♀ (MNHN-B 27355). — Stn DW 79, 19°11.55'S, 158°43.40'E, 58 m, *Halimeda* sand, 25.08.1988: 1 ♂, 3 ♀ (MNHN-B 27356). — Stn DW 93, 19°05.92'S, 158°53.00'E, 58-60 m, *Halimeda*, 27.08.1988: 2 ♂, 1 ♀ (MNHN-B 27357). — Stn 94, 19°06.00'S, 158°50.00'E, 36-53 m, boulders and *Halimeda*, 27.08.1988: 1 ♂ (MNHN-B 27358). — Stn 101, 19°08.99'S, 158°26.24'E, 37 m, *Halimeda* sand, 27.08.1988: 1 ♀ (MNHN-B 27359). — Stn DW 110, 19°08'95'S, 158°55.82'E, 48 m, shelly sand, 28.08.1988: 1 ♀ (MNHN-B 27360). — Stn DW 117, 19°25.10'S, 158°31.70'E, 52 m, *Halimeda* sand, 28.08.1988: 1 ♂ 16.2 x 18.9 mm (MNHN-B 26796). — Stn DW 135, 19°31.37'S, 158°19.14'E, 46 m, coarse sand, 30.08.1988: 1 ♀ (MNHN-B 27361). — Stn DW 136, 19°31.20'S, 158°16.00'E, 37 m, sand and boulders, 30.08.1988: 1 ♀ (MNHN-B 27362). — Stn DW 154, 19°52.04'S, 158°26.50'E, 35 m, *Halimeda* sand, 1.09.1988: 1 ♀ (MNHN-B 27363). — Stn DW 155, 19°49.08'S, 158°24.85'E, 42 m, foraminiferan sand, 01.09.1988: 1 ♀ (MNHN-B 27364). — Stn DW 166, 19°41.49'S, 158°25.24'E, 56 m, boulders, 2.09.1988: 1 ♀ (MNHN-B 27365).

Source : MNHN, Paris

New Caledonia. LAGON: stn 100, 22°32.6'S, 166°34.6'E, 15 m, shelly sand, 08.1984: 1 ♀ (MNHN-B 27318). — Stn 239, 22°24.3'S, 166°57.8'E, 43 m, coarse sand, 10.1984: 1 ♀ (MNHN-B 27319). — Stn 313, 22°40.3'S, 166°50.1'E, 30 m, coarse sand and *Halimeda*, 11.1984: 1 ♀ (MNHN-B 27331). — Stn 345, 22°46.4'S, 166°50.4'E, 39 m, white sand and corals, 11.1984: 2 ♀ (MNHN-B 27311). — Stn 353, 22°33.5'S, 167°00.8'E, 70 m, coarse sand and corals, 11.1984: 1 ♀ (MNHN-B 27312). — Stn 474, 18°02.4'S, 163°01.8'E, 52 m, *Halimeda* sand, 1.03.1985: 1 ♀ (MNHN-B 27332). — Stn 477, 18°51.0'S, 163°27.0'E, 50 m, *Halimeda* sand, 2.03.1985: 2 ♀ (MNHN-B 27320). — Stn 540, 19°06.2'S, 163°15.8'E, 35-40 m, *Halimeda* sand, 6.03.1985: 1 ♂ (MNHN-B 27333). — Stn 541, 19°06.0'S, 163°13.3'E, foraminiferan sand, 48-43 m, 6.03.1985: 1 ♀ (MNHN-B 27321). — Stn 601, 22°18.0'S, 167°02.5'E, 47-48 m, shelly sand, 5.08.1986: 1 ♀ (MNHN-B 27305). — Stn 708, 21°23.6'S, 166°05.2'E, 34-35 m, foraminiferan sand, 10.08.1986: 1 ♀ (MNHN-B 27313). — Stn 709, 21°22.2'S, 166°03.5'E, 39-40 m, foraminiferan sand, 10.08.1986: 1 ♀ (MNHN-B 27334). — Stn 710, 21°24.0'S, 166°02.5'E, 30-31 m, foraminiferan sand, 10.08.1986: 1 ♀ (MNHN-B 27335), 1 ♂ (MNHN-B 27306). — Stn 714, 21°21.0'S, 166°01.8'E, 37-38 m, foraminiferan sand, 11.08.1986: 1 ♂ (MNHN-B 27307). — Stn 747, 21°14.7'S, 165°50.9'E, 31-34 m, foraminiferan sand and *Halimeda*, 6.01.1987: 1 ♂ (MNHN-B 27322), 1 ♀ (MNHN- B 27323). — Stn 748, 21°16.9'S, 165°49.9'E, 35 m, coarse sand and *Halimeda*, 6.01.1987: 1 ♂ CL 14.5 mm (MNHN-B 26801), 1 ♂, 4 ♀ (MNHN-B 27324), 1 ♂ 15.5 x 18.1 mm (MNHN-B 26797). — Stn 749, 21°18.4'S, 165°18.4'E, 49 m, mud and shells, 6.01.1987: 1 ♀ (MNHN-B 27308). — Stn 765, 21°13.8'S, 165°41.8'E, 35 m, coarse sand, 8.01.1987: 1 ♀ (MNHN-B 27325). — Stn 780, 21°06.0'S, 165°39.2'E, 33 m, coarse sand, 8.01.1987: 1 ♂ (MNHN-B 27309). — Stn 782, 21°06.1'S, 165°36.7'E, 30 m, coarse sand, 8.01.1987: 1 ♀ (MNHN-B 27326). — Stn 788, 21°01.6'S, 165°34.7'E, 33 m, coarse sand, 9.01.1987: 1 ♀ (MNHN-B 27336). — Stn 794, 21°03.2'S, 165°30.9'E, 51 m, mud, 9.01.1987: 1 ♂, 2 ♀ (MNHN-B 27337). — Stn 795, 21°01.6, 165°32.0'E, 31 m, coarse sand, 9.01.1987: 3 ♂ (MNHN-B 27338). — Stn 801, 21°02.0'S, 165°29.3'E, 29 m, foraminiferan sand, 9.01.1987: 1 ♀ (MNHN-B 27339). — Stn 815, 21°54.1'S, 165°26.9'E, 32 m, coarse sand, 10.01.1987: 1 ♂ 8.2 x 9.7 mm (MNHN-B 26800). — Stn 821, 20°51.9'S, 165°23.2'E, 32 m, coarse sand, 10.01.1987: 2 ♂, 1 ♀ (MNHN-B 27314), 1 ♂ (MNHN-B 27341). — Stn 828, 20°50.1'S, 165°19.5'E, 28 m, coarse sand, 10.01.1987: 2 ♂ (MNHN-B 27327). — Stn 847, 20°37.6'S, 165°13.4'E, 28 m, fine sand, 11.01.1987: 1 ♀ (MNHN-B 27340). — Stn 867, 20°39.0'S, 165°01.3'E, 25 m, shell debris, 13.01.1987: 1 ♀ (MNHN-B 27328). — Stn DW 985, 20°20.3'S, 163°57.9'E, 15-17 m, coarse sand and *Halimeda*, 30.04.1988: 1 ♂ (MNHN-B 27315). — Stn DW 1094, 19°54.4'S, 163°41.2'E, 26 m, foraminiferan sand and *Halimeda*, 20.10.1989: 1 ♂ 5.1 x 5.0 mm (MNHN-B 26795). — Stn DW 1126, 19°33.0'S, 163°46.0'E, 41 m, coarse sand, 26.10.1989: 1 ♂ (MNHN-B 27316). — Stn DW 1139, 19°23.6'S, 163°47.0'E, 39 m, *Halimeda* sand, 27.10.1989: 6 ♀ (MNHN-B 27342).

Passe de Touho. Suction pump, 20 m, 18.09.1993: 1 ♀ (MNHN-B 27345).

Ilôt Maître. 22 m, P. BOUCHET coll., 28.09.1992: 1 ♀ (MNHN-B 27344).

TYPES. — *Lectotype* of *Cymopolia whitei* Miers, 1884: 1 ♂ 6.0 x 6.7 mm; paralectotypes 1 ♂ 5.8 x 6.5 mm, 2 ♀ 8.4 x 9.4 mm; 7.5 x 8.4 mm, *"Alert"*, stn 194 (BMNH 1882.24).

Holotype of *Palicoides ternatensis* Moosa & Serène, 1981: 1 ♂ 10.5 x 12.3 mm, MARIEL KING MEMORIAL EXPEDITION, stn HD I/1 (RDC CB2724).

TYPE LOCALITY. — Seychelles, *"Alert"*, stn 194, exact location unknown, 7-22 m.

DIAGNOSIS. — Carapace (Figs 42b, 61e; MIERS, 1884, pl. 49, fig. C; CALMAN, 1900, pl. 2, fig. 14; RATHBUN, 1911, pl. 19, fig. 10; MOOSA & SERÈNE, 1981, pl. 3, fig. A, as *P. ternatensis*; fig. 10) subquadrate, with large, low granules. Frontal border with two broad lobes separated by wide notch. Two truncate anterolateral teeth. Supraorbital borders each with one triangular inner lobe and smaller, rounded to slightly pointed outer lobe. Each eye peduncle with conspicuous, pointed, soft tubercle at distal end. Postorbital angles elongate, with pointed tips. Suborbital borders each with two rectangular to slightly rounded lobes (CALMAN, 1900, pl. 2, fig. 15). Segments 2-3 of antennae very wide, thick, numerous long setae. Each basal antennal segment expanded into thick, dorsoventrally-flattened process. Chelipeds with long carpi and meri in larger specimens of both sexes but extremely long and increasingly (but slightly) unequal in males (Figs 42b, 61e); dorsal borders of propodi with rounded or pointed tubercles; outer border with hook-like setae; long, simple and plumose setae along lower borders of cheliped propodi and fingers of males. Upper and lower borders of meri and anterior borders of carpi of second and third pairs of walking legs (P3-4) with very small, low tubercles (CALMAN, 1900, pl. 2, fig. 18). Abdomen of mature males narrow, with all segments free; one complete transverse ridge along segments 1-3 (incomplete one in segment 4, very low or absent in segments 5-6). Abdomen of immature males with segments 3-6 or 4-6 fused (MIERS, 1884, pl. 49, fig. c). First pleopods of small males (Fig. 43b; CALMAN, 1900, pl. 2, fig. 19; MOOSA & SERÈNE, 1981, fig. 9) with sinuous basal parts; distal part each with two flattened processes provided

Source : MNHN, Paris

with teeth. First pleopods of larger males (Figs 43c-d; MOOSA & SERÈNE, 1981, fig. 11, as *P. ternatensis*) with sinuous basal parts; each distal part with bent, toothed tip becoming enlarged as thick, arched process with thick teeth. Abdomen of mature females with segments 3-6 fused, one complete transverse ridge along each segment 1-2, two complete ridges along proximal portion of fused segment 3-6.

Color: A large male from New Caledonia photographed live (Fig. 61e) had a carapace that was mostly red and orange except a broad, dark-red band bordered by pink and orange blotches on the cardiac and intestinal regions, red chelipeds, and broad, red bands across the walking legs. Smaller males and females from the same region had a similar color pattern except that there was a broad band of red in the form of geometric patterns through the middle of the carapace. Many preserved specimens of both sexes had a dark dot on the median portion of the dactyli of the chelipeds and fifth pereopods (P5).

DISCUSSION. — The male first pleopods of *P. whitei* were illustrated by CALMAN (1900, pl. 2, fig. 19) and MOOSA & SERÈNE (1981, figs 9a-b). Their figures, however, are of the pleopods characteristic of small males, a situation found in those with a carapace length of up to 9.0 mm (5.1 x 5.0 mm; MNHN-B 26795) among the specimens that were examined. CALMAN did not give the size of this specimen; the specimen of MOOSA & SERÈNE had a carapace length of 9.2 mm (MOOSA & SERÈNE, 1981: 50). Such pleopods have sinuous basal parts (although MOOSA & SERÈNE described them as having a flattened shaft) and bifurcated distal parts (Fig. 43b). The ventral terminal process, the longest of the two, has rows of small teeth and its tip is dorsoventrally flattened and bordered by smaller teeth. As body size increases, the basal part of the pleopods becomes more distinctly sinuous, the two terminal processes and their teeth enlarge and the flattened tip of the ventral process bends downward (Fig. 43c). These were features used by MOOSA & SERÈNE (1981, figs 11a-d) to characterize their new species, *P. ternatensis*, here regarded as a subjective junior synonym of *P. whitei*. Nevertheless, there was not much difference between size of the only specimens examined by MOOSA & SERÈNE: one male *P. whitei* (9.2 x 10.6 mm) and one male, the holotype, of *P. ternatensis* (10.5 x 12.3 mm; RDC CB2724). The larger specimen identified as *P. ternatensis*, however, had all abdominal segments free, whereas the small male had "segments 3-5 soldered" (MOOSA & SERÈNE, 1981: 46), a characteristic of immature males (see below). In larger males the terminal processes of the pleopods are further enlarged (Fig. 43d). The ventral process gradually becomes thicker and arched, with thick teeth along its proximal portion and two rows of curved teeth along the outer (ventral) border. Whereas MOOSA & SERÈNE refer to the basal part of the pleopods of *P. whitei* and *P. ternatensis* as having a "flattened shaft", their figure of the pleopod of *P. ternatensis* (MOOSA & SERÈNE, 1981, fig. 11) clearly shows a sinuous basal part.

MOOSA & SERÈNE (1981) also used the relative length of the chelipeds to distinguish between the species of *Palicoides*, stating that it was shorter in *P. whitei* than in *P. longimanus* and intermediate in *P. ternatensis*. They based their conclusion using only a relatively small male of *P. whitei* and a slightly larger male of *P. ternatensis* (see above). Very long chelipeds where total length exceeds carapace length, however, characterize both species (Figs 42a-b). Chelipeds of *P. whitei* were longer than carapace length in all the males and females that were examined in this study except in the small males, where cheliped length was approximately equal to carapace length. The chelipeds of the largest *P. whitei* male examined in this study (16.2 x 18.9 mm; MNHN-B 26796) were 1.3 times longer than carapace length (cheliped meri 0.4 CL) but they were relatively longer in other specimens (15.5 x 18.1 mm [MNHN-B 26797], Fig. 61e; 8.6 x 9.6 mm [MNHN-B 26798], Fig. 42b). Differences in the relative length of chelipeds probably result from their loss and eventual regeneration in some individuals. Female chelipeds were always longer than carapace length but only reached a length slightly longer than carapace length (cheliped meri 0.3 CL) in the largest female examined (20.5 x 23.5 mm; MNHN-B 26799).

The number of abdominal segments also vary with increasing size. Immature males have segments 3-6 fused, but traces of sutures become progressively evident with increasing size until all segments are evident in mature males.

Another characteristic used by MOOSA & SERÈNE (1981: 46) to distinguish between the species of *Palicoides* is the presence in *P. longimanus* of irregular granules (larger on the branchial region) while being "of about the same sizes" in *P. whitei* and its subjective junior synonym *P. ternatensis*. This was found not to be true: larger specimens of both species have slightly larger granules on the branchial region.

Source : MNHN, Paris

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

Length relationship of pereopods 2-5 in *Palicoides whitei*

	P2	P3	P4	P5
Total length/CL	1.1-1.2	1.6-1.8	1.5-1.7	0.9
Merus length/CL	0.3-0.4	0.5	0.4-0.5	0.3
Dactylus length/Cl	0.3	0.4	0.4	0.1-0.2

MIERS (1884) based his description of *Cymopolia whitei* on four specimens without selecting a holotype. One of the four syntypes (♂ 6.0 x 6.7 mm, BMNH 1882.24) is hereby designated as the lectotype. A second male and two females from the same collection are paralectotypes.

SIZE. — Maximum size among specimens examined: 20.5 x 23.5 mm (female, MNHN-B 26799); 16.2 x 18.9 mm (male, MNHN-B 26796).

DISTRIBUTION. — Previously known from the Red Sea (LAURIE, 1915), Seychelles (MIERS, 1884; RATHBUN, 1911), Andaman Islands, India (ALCOCK, 1900), Halmahera (Moluccas) and Kai Islands (Banda Sea), Indonesia (MOOSA & SERÈNE, 1981, some records as *P. ternatensis*), Torres Strait (CALMAN, 1900), and Queensland, Australia (MCNEILL, 1968). Its distribution is now extended to Socotra, the Comoro Islands, Madagascar, Mauritius, Japan, and the Coral Sea (Chesterfield Islands, Chesterfield-Bellona Plateau, and New Caledonia) (Fig. 50). It is an inhabitant of coarse-sand sediments (particularly those rich in the coralline alga, *Halimeda*) that is associated with coral reefs. It has been collected from the same Coral Sea stations together with *P. longimanus* and the two species of *Neopalicus*. Depth: 7 m (MIERS, 1884) to 70 m.

Subfamily CROSSOTONOTINAE Moosa & Serène, 1981

Crossotonotinae Moosa & Serène, 1981: 52.

TYPE GENUS. — *Crossotonotus* A. Milne Edwards, 1873.

DIAGNOSIS. — Fifth pair of pereopods (P5) reduced in size but similar in shape to anterior walking legs (P2-4); articulation to carapace at same level as walking legs. All borders of carapace with teeth or rounded to pointed tubercles. Dorsal surface of carapace relatively flat or slightly convex except regions with high bosses or tubercles. No episternal process overhanging each posterolateral border of carapace posterior to fifth pair of pereopods. Epistome very narrow, not expanded dorsoventrally (vertically inclined). Abdomen of mature males and females with all segments free, segments 1-2 wide (not dorsoventrally compressed); transverse ridges complete, incomplete, or absent.

GENERA INCLUDED. — *Crossotonotus* A. Milne Edwards, 1873 and *Pleurophricus* A. Milne Edwards, 1873.

DISCUSSION. — The subfamily was established by MOOSA & SERÈNE (1981) to include *Crossotonotus* A. Milne Edwards, 1873, *Pleurophricus* A. Milne Edwards, 1873, and *Manella* Rathbun, 1906. *Manella* is here synonymized with *Crossotonotus* (see below). *Parapleurophrycoides* Nobili, 1906, sometimes included in the Palicidae but "discarded" by MOOSA & SERÈNE (1981: 52) since the description of its only species was based on a juvenile specimen, does not belong to the Palicidae at all (see below). The two genera that remain in the subfamily share, among several characters, a fifth pair of pereopods (P5) that is not greatly reduced in size, is similar in morphology to the anterior walking legs (P2-4), and is located at the same level as that of the remaining walking legs, that is, not dorsal to them as in the Palicinae. Other significant differences include the morphologies of the outline of the carapace and in the abdomen of both sexes.

Source : MNHN, Paris

Parapleurophrycoides Nobili, 1906 was described for *P. roseus* from French Polynesia (see also NOBILI, 1907; FOREST & GUINOT, 1962). It was questionably included, as *Pleurophrycoides* [*sic*], in the Palicidae by SERÈNE, (1968: 97) but "discarded" by MOOSA & SERÈNE (1981: 52) since the description of its only species "was a juvenile which can not be used for the definition of the genus". The very small male holotype (1.3 x 1.5 mm; MNHN-B 13091) is a xanthoid (P.K.L. NG, personal communication) and possibly, as stated by NOBILI (1907: 402), BALSS (1957: 1662), and TAKEDA & SHIMAZAKI (1974: 75), a pilumnid. A very small male specimen from the Gulf of Thailand identified as *P. roseus* (1.2 x 1.4 mm; ZMUC) by RATHBUN (1910: 358; also see NAIYANETR, 1980: 43; 1998: 119, as *Pleurophrycoides* [*sic*] *roseus*) is very close if not identical to NOBILI's species and therefore not a palicid either.

The shape and placement of the P5 in *Crossotonotus* and *Pleurophricus* in contrast with the rest of the palicids led to their placement in other groups of brachyurans. *Crossotonotus* was placed between "Ocypodidae and Plagusiinae" by A. MILNE EDWARDS (1873a: 258) and DE MAN (1888: 344) included his new species, *P. spinipes* (a junior subjective synonym of *Crossotonotus compressipes* A. Milne Edwards, 1873) among the Corystidae. A. MILNE EDWARDS (1873a: 260) placed *Pleurophricus* among the Oxystomata close to the Ocypodidae, while MIERS (1879: 660) included it among the Oxyrhyncha.

All members of the subfamily appear to be restricted to hard substrates in relatively shallow water. No species are known from outside the Indo-west Pacific region.

Key to the genera of the subfamily CROSSOTONOTINAE

1. Carapace subquadrate, with low bosses on dorsal surface and many small (10 to more than 20), rounded or pointed tubercles along posterior border ..... ***CROSSOTONOTUS*** A. Milne Edwards, 1873

— Carapace subcircular, with two very conspicuous, high bosses on metagastric region and few (5-6) larger, salient tubercles along posterior border ..... ***PLEUROPHRICUS*** A. Milne Edwards, 1873

Genus ***CROSSOTONOTUS*** A. Milne Edwards, 1873

Crossotonotus A. Milne Edwards, 1873a: 258 [82]. — A. MILNE EDWARDS, 1873b: 282. — SAKAI, 1965: 186; 1976: 595. — TAKEDA & SHIMAZAKI, 1974: 75. — HOLTHUIS, 1977: 187. — MOOSA & SERÈNE, 1981: 58.
Crossonotus - HASWELL, 1882: 95.
Manella Rathbun, 1906: 837. — MOOSA & SERÈNE, 1981: 53.

TYPE SPECIES. — *Crossotonotus compressipes* A. Milne Edwards, 1873 by monotypy. Gender: masculine.
Type species of *Manella* Rathbun, 1906: *Pleurophricus spinipes* De Man, 1888 by monotypy.

DIAGNOSIS. — Frontal border of carapace divided into 2-4 lobes (innermost lobes sometimes secondarily notched). Anterolateral borders each with pointed teeth. Dorsal surface of carapace with small granules and high granular bosses. Eyes spherical; peduncles with soft tubercles. Supraorbital borders each with two lobes. Suborbital borders each with two lobes. Each basal antennal segment rectangular but outer side can be slightly expanded. Epistome very narrow, with conspicuous, triangular median teeth. Chelipeds unequal in males and females. Walking legs (P2-5) with flattened carpi, propodi, and dactyli. First (P2) and fourth (P5) pairs shorter than second and third pairs (P3-4). Borders of meri of P2-5 with equal or nearly equal tubercles; carpi, propodi, and dactyli with teeth along anterior and posterior borders. P5 reduced (0.9-1.0 CL), thick and flattened. Abdomen of mature males elongate (sides parallel to each other), with all segments free. Male first pleopods long and slender; basal parts sinuous; each distal part uniramous (secondary, proximal tip may be present), tip with minute teeth. Abdomen of mature females with all segments free.

Source : MNHN, Paris

REDESCRIPTION. — Carapace subquadrate, slightly broader than long, with low, granular bosses. Anterolateral borders each with a continuous row of teeth; posterolateral borders with tubercles, straight or slightly rounded, with marked junction with convex posterior border. Confluence of branchial and mesogastric regions depressed and smooth; no conspicuous sulcus between hepatic and branchial regions. Posterior border with many rounded or pointed tubercles. Thoracic sternite 7 without episternal process visible dorsally.

Frontal border divided into 2-4 pointed or rounded lobes (if four, inner pair more advanced anteriorly than outer pair, may be secondarily lobed). Supraorbital borders each with two triangular or rounded lobes. Postorbital angles conspicuous, with long and pointed tips. Cornea of eyes spherical, slightly wider than base of eye peduncle; peduncle with granular tubercles at least on distal border. Orbits deep.

Suborbital border with two broad, rounded lobes usually bordered by long teeth or pointed tips. Pterygostomial lobe at each anterolateral angle of buccal frame broad, bordered by long teeth or slightly pointed.

Each basal antennal segment rectangular, with or without small, outward expansion. Epistome very narrow, not expanded dorsoventrally, vertically inclined. Border of epistome with two triangular, pointed median teeth (plus two triangular, pointed outer processes) connecting distally with each pterygostomial lobe. Meri of third maxillipeds smaller and narrower than ischia.

Chelipeds unequal in males and females. First (P2) and fourth (P5) pairs of walking legs shorter than second and third pairs (P3-4). Walking legs (P2-5) with flattened carpi, propodi, and dactyli; anterior (dorsal) and posterior (ventral) borders of meri with pointed teeth and rows of tubercles on dorsal and ventral surfaces; anterior and posterior borders of carpi, propodi, and dactyli with teeth. Second and third pairs of walking legs (P3-4) each with broad coxae, having flattened, thin-edged anterior and posterior borders.

Abdomen of mature males elongate, with both sides almost parallel to each other, with all segments free, and no transverse ridges; first segment broad and long. Male first pleopods long and slender; basal parts sinuous; each distal part uniramous (secondary, proximal tip may be present), tip bordered by minute teeth. Second male pleopods short, slightly thick, slightly curved; distal segment with blunt tip.

Abdomen of mature females broad, rounded, with all segments free and no transverse ridges; first segment broad and long. Abdomen of immature females triangular (but broader than in males), with all segments free.

SPECIES INCLUDED. — *C. compressipes* A. Milne Edwards, 1873, *C. spinipes* (De Man, 1888), *C. ceramensis* (Moosa & Serène, 1981), and *C. lophocheir* sp. nov.

SEXUAL DIMORPHISM. — The largest specimen known for *C. spinipes* is a male, the only case among Indo-west Pacific palicids. The chelipeds are unequal in both sexes in *C. spinipes* but a conspicuous, dense cluster of plumose setae is found only on the inner surface of the propodi and fingers of male chelipeds. The lower margin of the large cheliped of males has a series of sinuous ridges, presumably a stridulating surface (RATHBUN, 1911).

DISCUSSION. — *Crossotonotus* was established by A. MILNE EDWARDS (1873a) for a new species, *C. compressipes*, which was described using specimens from Samoa. The genus was considered not to belong to any known family of the Catometopa and was placed "between Ocypodidae and Plagusiinae" (A. MILNE EDWARDS, 1873a: 258).

A second species, *Pleurophricus spinipes*, was described from Ambon, Indonesia by DE MAN (1888), who placed it in *Pleurophricus* A. Milne Edwards, 1873. RATHBUN (1906) identified *P. spinipes* from the Hawaiian Islands but created *Manella* (with *P. spinipes* De Man as the type species) to recognize the position of the species as a palicid based on the relative size of its walking legs: "I have separated generically DE MAN's species from the type of *Pleurophricus* on account chiefly of the legs" (RATHBUN, 1906: 837). The legs of RATHBUN's species (*Manella spinipes* Rathbun, 1906) were found to be similar to those of other palicids (that is, first and fourth walking legs smaller than the second and third) whereas the legs of *Pleurophricus cristatipes* A. Milne Edwards, 1873, originally the only species in the genus, were more similar in size and therefore not considered palicid-like (RATHBUN, 1906). RATHBUN (1911), WARD (1933), MONOD (1938), SAKAI (1939), EDMONDSON (1933, 1946, 1962) and ZARENKOV (1968) followed RATHBUN (1906) and placed *C. compressipes* and *P. spinipes* under *Manella*. Three additional species were eventually added: *M. gardineri* Rathbun, 1911, *M. brevimana* Ward, 1933,

Source : MNHN, Paris

and *M. ceramensis* Moosa & Serène, 1981. SAKAI (1965, 1974, 1976), however, regarded *Manella* as a synonym of *Crossotonotus*, a view followed by SERÈNE (1968), HOLTHUIS (1977) and MCNEILL (1968). MOOSA & SERÈNE (1981: 60) examined the type material of *C. compressipes* and mistakenly concluded that it was different from *Manella*, although they stated that the genera "are close one from another and perhaps identical". They restricted *Crossotonotus* to the type material of *C. compressipes* that was examined (MNHN-B 3078) plus three additional specimens examined by WARD (1933).

The figure that was published following the description of *C. compressipes* (A. MILNE EDWARDS, 1873b: pl. 13, fig. 1) shows a rounded carapace that lacks a noticeable junction between the posterolateral borders and a convex posterior border. This character was unfortunately used by MOOSA & SERÈNE (1981) to separate *Crossotonotus* from *Manella*. In the type material of *C. compressipes* (MNHN-B 3078), the posterior edge of the carapace is slightly convex and there are noticeable junctions with each posterolateral border.

Key to the species of *CROSSOTONOTUS*

1. Carapace subquadrate, depressed; pointed or broad, straight-edged anterolateral teeth **2**
— Carapace subcircular, dorsally convex; rounded anterolateral teeth .....
.....***C. compressipes*** A. Milne Edwards, 1873

2. Dorsal border of propodus of cheliped with two rows of short tubercles **3**
— Dorsal border of propodus of cheliped with one large, rounded tubercle .....
..... ***C. lophocheir*** sp. nov.

3. Frontal lobes broad with tips bent upward or rounded (in smaller individuals). Inner surface of cheliped propodi (distal portions) and fingers (proximal borders) of males with dense clusters of plumose setae ..... ***C. spinipes*** (De Man, 1888)
— Frontal lobes broadly rounded and only slightly protuberant. Inner surface of cheliped propodi of males without clusters of setae ..... ***C. ceramensis*** (Moosa & Serène, 1981)

Crossotonotus compressipes A. Milne Edwards, 1873

Figs 44, 51

Crossotonotus compressipes A. Milne Edwards, 1873a: 259 [83]. — A. MILNE EDWARDS, 1873b: 283, pl. 13, figs 1, 1a-f. — WARD, 1933: 389. — SAKAI, 1965: 186. — MCNEILL, 1968: 81. — SERÈNE, 1968: 96. — MOOSA & SERÈNE, 1981: 60. — FRANSEN *et al.*, 1997: 152. — MURAOKA, 1998: 49.
Crossonotus [*sic*] *compressipes* - HASWELL, 1882: 96.
Crossotonotus taketomiensis Sakai, 1974: 94; 1976: 596, fig. 326.
Crosstonotus [*sic*] *taketomiensis* - NAGAI & NOMURA, 1988: 197, color photograph.

MATERIAL EXAMINED. — **Japan**. *Ishigaki Islands, Taketomi Island*. Taketomi Island, Ishigaki Islands, Ryukyu Islands, T. SAKAI coll., 25.10.1973: 1 juv. ♂ holotype of *Crossotonotus taketomiensis* Sakai, 1974, 5.7 x 6.1 mm (SMF 24716).
No locality. 1 ♂ (SMF 24717).
Indonesia. *Moluccas*. RUMPHIUS EXPEDITION I: stn Li-1, Ambon, 03°36'06"S, 128°14'58"E, KASIJAN coll., 15.01.1973: 1 ♀ (MNHN-B 10014).
Papua New Guinea. *Bismark Archipelago*. New Britain Island, Ralum, coral reef, S. DAHL coll., 4.09.1986: 1 ♀ (ZMB 18167).
Australia. *Queensland*. Hope Islands. 12°28'S, 145°15'E, A.R. MCCULLOCH coll., 1905: 1 ♂ (AM P3740).
Low Isles. GREAT BARRIER REEF EXPEDITION: 1 ♀ 9.5 x 10.5 mm (BMNH 1950.12.1.28).
New Caledonia. Nouméa, baie des Citrons, under rock, 1 m, G. PAULAY coll., 18.05.1999: 1 ♀ (MNHN-B 27138).
Unknown locations. M. BALANSA coll.: 1 ♀ 7.0 x 7.3 mm (MNHN-B 26272). — BOUGRIN ? coll., 1903: 1 ♀ (MNHN-B 13251).
Samoa. *Upolu*. 1 ♀ lectotype 8.4 x 9.5 mm, 1 ♀ paralectotype 6.4 x 7.4 mm (MNHN-B 3078). — 2 ♀ 6.7 x 8.0 mm, 7.3 x 8.7 mm (SMF 1747). — 2 ♀ 6.7 x 7.1 mm, 7.0 x 7.4 mm (ZMUC CRU-3623).

Source : MNHN, Paris

TYPES. — *Lectotype*: 1 ♀ 8.4 x 9.5 mm, Samoa (MNHN-B 3078).

Paralectotypes: 1 ♀ 6.4 x 7.4 mm, Samoa (MNHN-B 3078).

Holotype of *Crossotonotus taketomiensis* Sakai, 1974: 1 ♂ 5.7 x 6.1 mm, Taketomi Island, Ishigaki Islands, Ryukyu Islands, T. SAKAI coll., 25.10.1973 (SMF 24716).

TYPE LOCALITY. — Upolu, Samoa, unknown depth.

DIAGNOSIS. — Carapace (Fig. 44a) subcircular, dorsoventrally convex, with large, low bosses. Five to six broad, rounded anterolateral teeth on each side of carapace, followed by 3-4 slightly smaller, rounded tubercles along each posterolateral border; 9-14 rounded tubercles along convex posterior border separated from posterolateral border by clear junction. Supraorbital borders each with two short, slightly rounded lobes. Four rounded to slightly pointed lobes along anterior border; median lobes slightly broader and longer than outer lobe. Suborbital borders (Fig. 44b) each with two pointed lobes, proximal bifurcated. Dorsal borders of cheliped propodi each with two rows of rounded tubercles; lower border of propodus of largest cheliped straight. Dactyli of P2-4 with teeth along anterior and posterior borders (two on posterior borders of P4); dactyli of P5 (Fig. 44c) with 3-4 spines along posterior borders. Abdomen of mature males and females with all segments free (A. MILNE EDWARDS, 1873b, pl. 13, figs 1e, 1f). Male first pleopods (Figs 44d-e) with sinuous basal parts; each distal part straight, one simple tip bordered by conspicuous teeth.

Color: A color photograph in NAGAI and NOMURA (1988: 197) identified as *C. taketomiensis*, a junior synonym of *C. compressipes*, shows an individual partially camouflaged against a hard substrate in an Okinawa coral reef. The carapace of the specimen is pinkish brown, with a bright yellow spot on the cardiac region flanked on each side by a greenish spot. The legs and clumps of setae across the dorsal surface of the carapace are gray.

DISCUSSION. — *C. compressipes* was actually described twice by A. MILNE EDWARDS (1873a, 1873b), with both publications appearing in the same year. Unfortunately, it has not been possible to obtain information on which of the two was first published. The descriptions are identical except that in one of the two (A. MILNE EDWARDS, 1873b: 284) there is information on additional material from New Caledonia, which leads to belief that it was written after the intended description (A. MILNE EDWARDS, 1873a).

Two dry female specimens from Samoa that were originally deposited at the Godeffroy Museum, Hamburg and the source of specimens used in the description, were designated by MOOSA & SERÈNE (1981) as the "holotype" and "paratype" of *C. compressipes*. Since A. MILNE EDWARDS had not selected a holotype, the two specimens were actually syntypes. The selection of a "holotype" and a "paratype" among the syntypes by MOOSA & SERÈNE was incorrect and therefore the two selected specimens are a lectotype and a paralectotype respectively, not a holotype (International Code of Nomenclature, fourth edition, 1999, Article 74.1). Both specimens are small (lectotype 8.4 x 9.5 mm, paralectotype 6.4 x 7.4 mm; MNHN-B 3078). A photograph of one of the specimens of the type material, perhaps the lectotype, is probably shown in a photograph in MOOSA & SERÈNE (1981, pl. 3, fig. D). They are similar to the measurements given by A. MILNE EDWARDS (1873a: 259 [83]) in his description (8 x 9 mm). The number of lateral teeth given in the description (10-12) agree with the number observed in the lectotype and paralectotype but not in the case of the posterior teeth: 12 in the specimen against 6-8 in the description. Some of the posterior teeth are rounded and broad, while others are small and pointed and perhaps they were not taken into account. The posterior border of the paralectotype is damaged. The carapace of a third dry specimen from New Caledonia presumably examined by A. MILNE EDWARDS (MNHN-B 26272) is in poor condition. The figure given by A. MILNE EDWARDS (1873b, pl. 13, fig. 1) shows a rounded carapace bordered by similar rounded teeth, of which 12 may be interpreted as lateral. The number of posterior teeth cannot be determined.

Two alcohol-preserved females from Samoa (6.8 x 7.3 mm, 8.0 x 8.7 mm; SMF 1747), originally at the Godeffroy Museum as the type material, have eight lateral teeth on the left side and nine on the right. The largest specimen has 14 uneven posterior teeth and the smallest 12, also uneven. Two other alcohol-preserved females from Samoa that had also been deposited at the Godeffroy Museum (6.7 x 7.1 mm, 7.0 x 7.4 mm; ZMUC CRU-3623). The other specimens examined are similar to the type material and the remaining Godeffroy Museum specimens. A small female from New Caledonia (6.9 x 7.2 mm; MNHN-B 13251) had 10 lateral and nine

Source : MNHN, Paris

posterior teeth and tubercles, all rounded. A female specimen from the Great Barrier Reef (9.5 x 10.5 mm; BMNH 1950.12.1.28) had similarly shaped teeth and tubercles (nine lateral, 12 posterior).

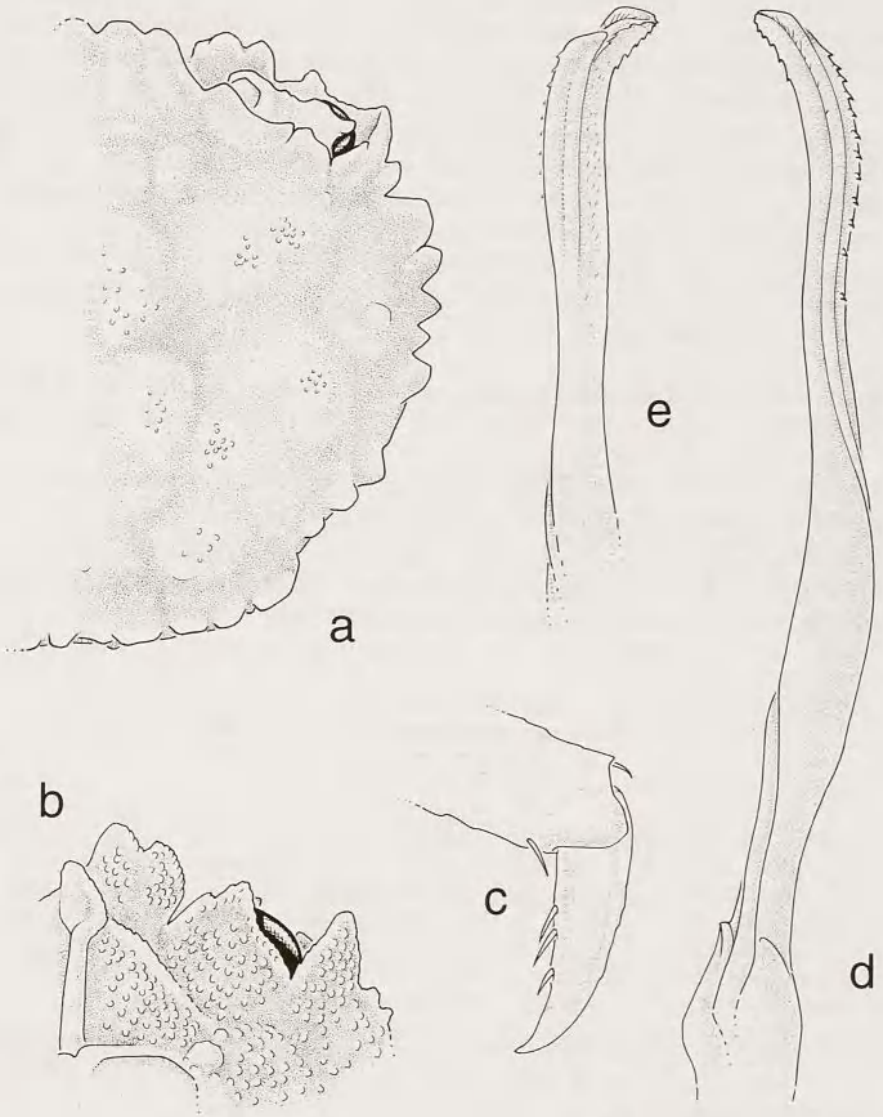


FIG. 44. — *Crossotonotus compressipes* A. Milne Edwards, 1873: **a-c**, ♀ 7.3 x 8.7 mm, Upolu, Samoa (SMF 1747): **a**, carapace, dorsal view; **b**, suborbital border; **c**, dactylus, right fifth pereopod, dorsal view. — **d-e**, ♂ 9.9 x 10.9 mm, Hope Islands, Queensland, Australia (AM P3740): **d**, left male first pleopod, lateral view (outer side) view; **e**, left male first pleopod, distal end (inner side).

According to L.B. HOLTHUIS (*in litt.*), the Godeffroy Museum offered specimens of *C. compressipes* for sale (Museum Godeffroy, *Catalog V*, 1874, p. 75). Subsequent issues of their catalogues (*VI-IX, 1877-1884*) did not list any specimens so specimens were probably sold, which explains their presence in Frankfort (SMF 1747), Copenhagen (ZMUC CRU-3623), and Berlin (ZMB 4463, lost).

C. taketomiensis was described by SAKAI (1974) from two small specimens collected in the southern Ryukyu Islands. The species was distinguished from *C. compressipes* mostly by the shape of the teeth along the carapace borders. The holotype of *C. taketomiensis* (male, 5.7 x 6.1 mm; SMF 24716), however, is almost identical to the lectotype of *C. compressipes*. SAKAI (1974: 95; 1976: 597) stated that the teeth on the anterior border of

Source : MNHN, Paris

C. taketomiensis were rounded, in contrast to those of *C. compressipes*. A. MILNE EDWARDS, however, described them as rounded and they are shown as such in the figure that accompanied the description (A. MILNE EDWARDS, 1873b, pl. 13, fig. 1). Although the number of teeth along the rest of the carapace borders were found to be similar in both species, SAKAI (1974: 95; 1976: 597) characterized them as "variable in size and their tips obtusely pointed" in contrast to the rounded, similar teeth shown in A. MILNE EDWARDS' figure. SAKAI, nevertheless, mistakenly used the shape of the first anterolateral tooth ("very prominent and acuminate") to contrast between the two species. It is the second tooth, however, that is the largest of the three anterolateral teeth in the holotype of *C. taketomiensis* and the lectotype of *C. compressipes*. The serration of the anterior borders of the meri of the walking legs is a characteristic of the species found in both type specimens, although SAKAI noted to be entire in *C. compressipes*, obviously based only on A. MILNE EDWARDS' figure. SAKAI (1974: 95; 1976: 597) also used the presence of plumose setae on the chelipeds of *C. compressipes* (in contrast to their absence in *C. taketomiensis*). Although A. MILNE EDWARDS (1873b: 284) mentions that setae were present on the inner surface of the small chelipeds ("poils sur sa face interne"), no dense clusters of setae were observed in specimens of *C. compressipes*, as is the case of the male of *C. spinipes*.

SIZE. — Maximum size among specimens examined: 9.5 x 10.5 mm (female, BMNH 1950.12.1.28); 9.9 x 10.9 mm (male, AM P3740).

DISTRIBUTION. — Known from Japan (SAKAI, 1974, 1976, both as *C. taketomiensis*), Solomon Islands (WARD, 1933), Queensland, Australia (HASWELL, 1882; MCNEILL, 1968), New Caledonia (A. MILNE EDWARDS, 1873b), and Samoa (A. MILNE EDWARDS, 1873a, 1873b). Its range is now extended to Ambon (Indonesia) and the Bismark Archipelago (Papua New Guinea) (Fig. 51). It appears to have been collected only in shallow water: "reef flat at low tide" (MCNEILL, 1968: 81) and "coral reef" (SAKAI, 1974: 95).

Crossotonotus spinipes (De Man, 1888)

Figs 45, 46, 51, 61f

Pleurophricus spinipes De Man, 1888: 344, pl. 15, figs 1, 1a-c.
Manella spinipes - RATHBUN, 1906: 837, fig. 3, pl. 7, fig. 6. — EDMONDSON, 1933: 268, fig. 158b; 1946: 310, fig. 184b; 1962: 12, figs 2e, 4f. — WARD, 1933: 389. — MONOD, 1938: 153, figs 26D-E, 29 (as "?*Manella spinipes*"). — SAKAI, 1939: 610, pl. 103, fig. 3; 1956: 52. — GUINOT, 1967: 280. — ZARENKOV, 1968: 762. — YANG, 1979: 34.
Manella gardineri Rathbun, 1911: 240, pl. 20, fig. 9. — WARD, 1933: 389. — GUINOT, 1967: 280.
Manella brevimana Ward, 1933: 387, pl. 21, figs 7-8. — MOOSA & SERÈNE, 1981: 54, figs 12 a-b, 13 a.
Crossotonotus spinipes - SAKAI, 1965: 187, fig. 25, pl. 89, fig. 4; 1976: 596, pl. 206, fig. 1. — CHEN, 1975: 167, fig. 9, pl. 2, fig. 3. — HOLTHUIS, 1977: 187. — DAI *et al.*, 1986: 414, fig. 229 A. — DAI & YANG, 1991: 450, fig. 229A. — WADA, 1995: 418, pl. 118, fig. 11.
Crossotonotus gardineri - SERÈNE, 1968: 97.
Crossotonotus brevimanus - SERÈNE, 1968: 97.
Crossotonotus sp. - TAKEDA & SHIMAZAKI, 1974: 75, pl. 2, fig. B.

MATERIAL EXAMINED. — **Red Sea**. *Al Sayad.* Stn 23, R. DOLLFUS coll., 30.12.1928: 1 ♀ (MNHN-B 13255).
Port Sudan. Wingate Reef, stn SAN-166, V. NEUMANN coll., 5 m, on dead corals, 21.09.1992: 2 ♀ (SMF 24541). — Sanganeb Atoll, stn SAN-120, V. NEUMANN coll., 6-10 m, on dead corals, 3.10.1992: 1 ♀ (SMF 24542).
Seychelles. REVES 2: stn 47, 04°03.8'S, 55°59.5'E, 45-55 m, shelly sand, 14.09.1980: 1 ♂ (MNHN-B 27131).
Amirante Islands. *"Sealark"*: stn E21, 55 m, 17.10.1905: 1 juv. ♂ 8.7 x 10.0 mm, 1 ♂ 10.1 x 12.1 mm, holotype of *Manella gardineri* Rathbun, 1911 (USNM 41364).
La Réunion. M. PEYROT-CLAUSADE coll.: 1 juv. (MNHN-B 26275).
Sri Lanka. *Trincomalee*, south side of first bay north of harbor, 26 m, C. KOENIG coll., 5.04.1970: 1 ♀ (USNM).
Japan. *Boso Peninsula.* Katsuura. Rocky shore intertidal, A. ASAKURA coll., 23.08.1995: 1 ♂ (CBM-ZC 1931).
Miura Peninsula. Washed up at Nahama beach, H. IKEDA coll., 05.1995: 1 ♀ (HSM).
Shimoda ?: 1 ♀ (SMF 24711).
Wagu. 2 ♀ (SMF 24712). — From lobster nets, 10-15 m, H. IKEDA coll., 04.1980: 1 ♂ (HSM).
Kii Nagashima. YAMAMOTO coll., 12.1963: 1 ♂ (SMF 24713).

Source : MNHN, Paris

Ryukyu Islands. Okinawa, off Horseshoe Cliffs, 26°30.0'N, 127°50.9'E, 57.9 m, R.F. BOLLAND coll., 18.04.1981: 1 ♀ (USNM).

Miyako Islands. Irabujima Island, 12 m, in cave, S. NAKATANI coll., 17.07.1999: 1 ♀ 31.5 x 35.8 mm (MNHN-B 26802).

Ishigaki Islands. Ohama, 27.08.1977: 1 ♂ (SMF 24714).

No locality. 1 juv. ♀ (SMF 24715).

Taiwan. *Lan Yu (= Orchid) Island*. Night diving, 5 m, S.-H. WU coll., 8.07.1997: 1 juv. ♀ 26.6 x 30.0 mm (NTOU).

Viet Nam. Nhatrang, R. SERÈNE coll., 13.08.1964: 1 ♂ (MNHN-B 9765).

Singapore. Sultan Shoal, 18-24 m, 12.1933: 1 ♀ (ZRC 1965.8.2.234).

Indonesia. *Timor*. SIBOGA EXPEDITION: stn 303, Samau Island, 10°27.9'S, 123°28.7'E, 36 m, *Lithothamnion*, 2-5.02.1900: 1 ♀ (ZMA De 203890).

Papua New Guinea. *Hansa Bay*. Laing Island lagoon, 4°11.62'S, 144°51.46'E, 5 m, in *Pocillopora damicornis* colony, S. DE GRAVE coll., 25.10.1993: 1 juv. ♀ (MNHN-B 27031).

Capricorn Group. North West Island, 23°18'S, 151°22'E, under large spreading coral in pool, outer edge of reef, M. WARD coll., 12.1929: 1 ♂ holotype of *Manella brevimana* Ward, 1933 14.1 x 16.5 mm (AM P10636).

Chesterfield Islands - Chesterfield-Bellona Plateau. CHALCAL 1: stn D 51, 21°13.21'S, 158°42.50'E, 55 m, 07.1984: 1 ♂ juv. (MNHN-B 27129).

CORAIL 2: stn DW 104, 19°08.95'S, 158°35.67'E, 49 m, boulders, 27.08.1988: 1 ♂ (MNHN-B 27098). — Stn CP 127, 19°27.73'S, 158°27.30'E, 44-45 m, boulders and corals, 29.08.1988: 1 ♀ (MNHN-B 27119).

New Caledonia. LAGON: stn 427, 22°41.9'S, 167°18.0'E, 60 m, boulders and corals, 25.01.1985: 1 ♂ (MNHN-B 27127). — Stn 428, 22°40.7'S, 167°16.4'E, 56 m, *Halimeda* sand, 25.01.1985: 1 juv. ♀ (MNHN-B 27094). — Stn 477, 18°51.0'S, 163°27.0'E, 50 m, *Halimeda* sand and boulders, 2.03.1985: 1 ♀ (MNHN-B 27128). — Stn 606, 22°12.8'S, 167°00.5'E, 46-48 m, corals, 5.08.1986: 1 ♂, 1 ♀ (MNHN-B 27122). — Stn 625, 21°59.2'S, 166°53.6'E, 34-40 m, *Halimeda* sand and corals, 6.08.1986: 1 ♂ (MNHN-B 27096). — Stn 635, 21°57.7'S, 166°44.5'E, 52-45 m, boulders and corals, 6.08.1986: 1 juv. ♀ (MNHN-B 27095). — Stn 640, 21°54.8'S, 166°45.8'E, 50-80 m, *Halimeda* sand, 7.08.1986: 1 ♀ (MNHN-B 27130). — Stn 650, 21°49.3'S, 166°37.7'E, 50 m, boulders and *Halimeda*, 7.06.1986: 1 ♀ (MNHN-B 27123). — Stn 657, 21°48.2'S, 166°33.7'E, 40-42 m, *Halimeda* sand, 8.08.1986: 1 ♀ (MNHN-B 27100). — Stn 659, 21°45.3'S, 166°33.4'E, 46-48 m, boulders and corals, 8.08.1986: 1 ♂ (MNHN-B 27120). — Stn 662, 21°44.0'S, 166°32.0'E, 50 m, boulders and corals, 8.08.1986: 1 ♂ 10.6 x 12.8 mm (MNHN-B 26810), 1 ♂ (MNHN-B 26215). — Stn 668, 21°40.5'S, 166°29.1'E, 40 m, boulders and corals, 8.08.1986: 1 ♂ (MNHN-B 27097). — Stn 769, 21°12.0'S, 165°40.2'E, 39 m, coarse sand, 8.01.1987: 1 ♂ (MNHN-B 27099).

EXPÉDITION MONTROUZIER: Touho, 09.1993: 1 juv. ♂ (MNHN-B 27125).

Récif Mbere. 22°19.9'S, 166°13.2'E, outer reef slope, 25-30 m, P. BOUCHET coll., 5.05.1993: 1 juv. ♀ (MNHN-B 27121). — 7.01.1993: 1 ♂, 1 juv. ♂, 1 juv. ♀ (MNHN-B 27126).

Passe de Dumbéa. Outer reef, under coral ridge, night diving, 12 m, 8.01.1999: 1 ♂ 36.9 x 43.3 mm (MNHN-B 26803).

Norfolk Ridge. SMIB 5: stn DW 100, 23°22.90'S, 168°05.20'E, 80-120 m, sand, 14.09.1989: 1 ♂ (MNHN-B 27124).

Unknown location. — Night diving, 20 m, P. LABOUTE coll., 19.11.1988: 1 ♀ (MNHN-B 26811).

Fiji. Great Astrolabe Reef, off north tip of Dravuni Island, stn WE 83-27, poison station, 10-15 m, 29.03.1983: 1 ♂ (USNM).

TYPES. — *Holotype* of *Pleurophricus spinipes* De Man, 1888: 1 juv. ♂ 7.0 x 8.5 mm (DE MAN, 1888), J. BROCK coll., Ambon, Indonesia. Deposit unknown (material lost ?).

Holotype of *Manella gardineri* Rathbun, 1911: Amirante Islands, western Indian Ocean, *"Sealark"*, stn E21, 55 m, 17.10.1905: 1 ♂ 10.1 x 12.1 mm (USNM 41364).

Holotype of *Manella brevimana* Ward, 1933: 1 ♂ 14.1 x 16.5 mm, North West Island, Capricorn Group, Queensland, Australia, 23°18'S, 151°22'E, under large spreading coral in pool, outer edge of reef, M. WARD coll., 12.1929 (AM P10636).

TYPE LOCALITY. — Ambon, Moluccas, Indonesia, unknown depth.

DIAGNOSIS. — Carapace (Figs 45a, 46, 61f) subquadrate, depressed, with large, slightly swollen areas with low bosses topped by rounded tubercles. Three broad, pointed anterolateral teeth (second typically bifurcated) on each side of carapace, followed by 3-4 large, pointed or blunt tubercles along each lateral border, 4-6 similar but slightly smaller, pointed tubercles along each posterolateral border; 17-24 pointed or blunt tubercles along convex posterior border separated from posterolateral border by clear junction. Supraorbital borders each with two triangular lobes (sometimes bifurcated). Four lobes along anterior border; tips bent upward, median lobes broader and notched with increasing carapace size (lobes rounded, median lobes slightly longer than outer lobes, and with entire borders in

Source : MNHN, Paris

very small specimens). Suborbital borders (Fig. 45b) each with two broad, rectangular lobes bordered by long, narrow teeth. Dorsal borders of cheliped propodi each with two high and conspicuous rows of pointed to rounded tubercles; cluster of abundant plumose setae on inner, distal surface of propodi and proximal border of fingers in males (less abundant, shorter setae in largest females); propodus of largest cheliped very high, with lower border expanded to form J-shaped proximal edge. Dactyli of P2-4 with teeth along anterior and posterior borders (three on posterior borders of P4); dactyli of P5 (Fig. 45c) with 2-3 spines along posterior borders. Abdomen of mature males (Fig. 45d) with all segments free (all fused in juveniles). Male first pleopods (Fig. 45e; MOOSA & SERÈNE, 1981, figs 12a-b) with sinuous basal parts; each distal part straight, one simple tip bordered by minute teeth.

Color: Orange carapace and legs (Fig. 61f). A light spot on the cardiac region was observed in two specimens from New Caledonia. Red spots flanked the yellow spot of one.

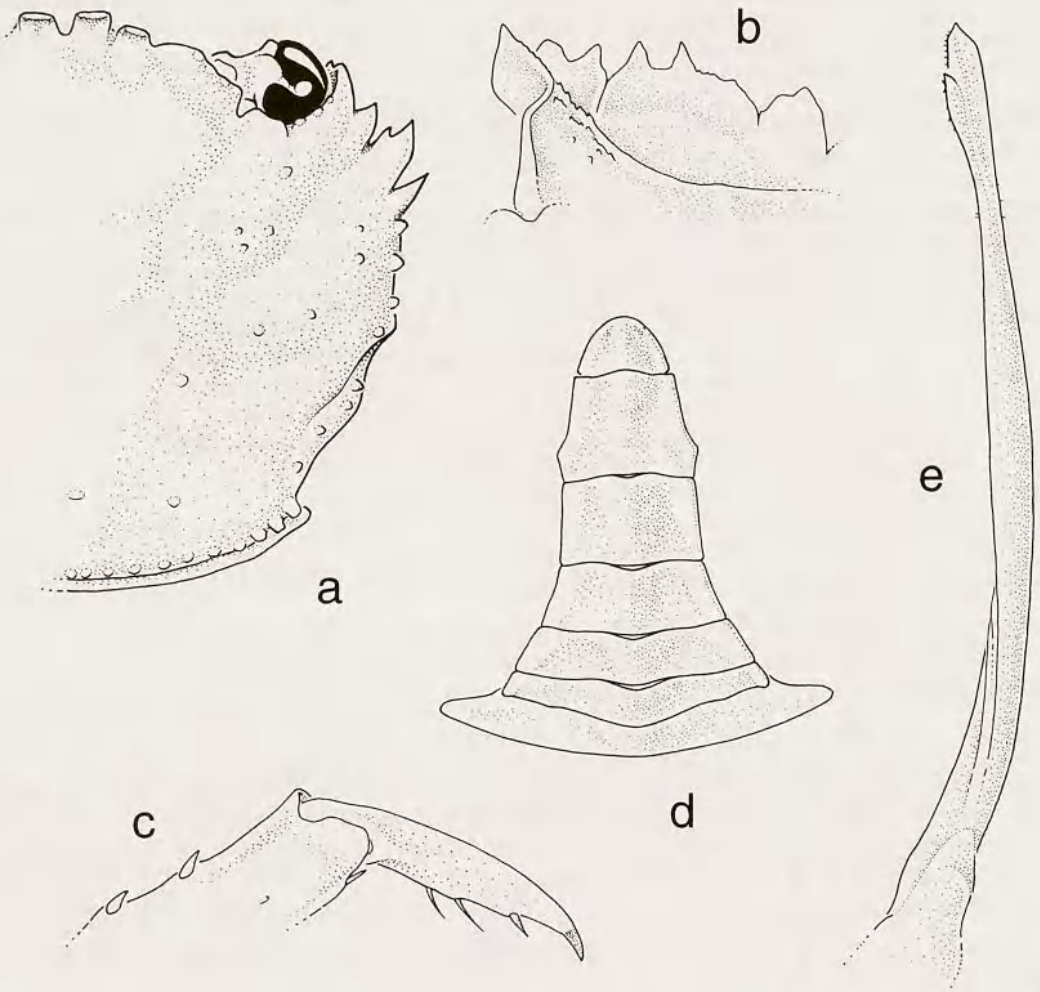


FIG. 45. — *Crossotonotus spinipes* (De Man, 1888), ♂ 10.6 x 12.8 mm, east coast of New Caledonia, LAGON, stn 662, 50 m (MNHN-B 26810): **a**, carapace, dorsal view; **b**, suborbital border; **c**, dactylus, right fifth pereopod, dorsal view; **d**, abdomen; **e**, left male first pleopod, lateral (inner side) view.

DISCUSSION. — The chelipeds of *C. spinipes* are very unequal in both sexes, the largest having a much thicker and higher propodus. Each finger of the largest cheliped has one cutting edge plus broad teeth in the largest specimens. The fingers of the smaller cheliped has spoon-shaped tips and short, rounded teeth along the distal half. In males there is a dense cluster of plumose setae at the distal end of the propodus and proximal portion of the finger on the inner surface of both chelipeds. Shorter and less dense setae, however, are found in the largest females.

Source : MNHN, Paris

The lower border of the propodus of the largest cheliped has low undulating ridges that were referred to as "stridulating lines" by RATHBUN (1911: 241). Their function remains unknown. Males do not seem to have a specialized plectrum, the structure rubbed by the cheliped to emit sound. Two possibilities for the plectrum are the teeth along the dorsal border of the second walking leg or the tubercles on the dorsal border of the small cheliped. Both of these structures are nevertheless also found in females.

The fourth pair of walking legs (P5) is identical in shape to the other walking legs, in sharp contrast to the members of the subfamily Palicinae where the segments are much more slender. The P5 of *C. spinipes* have the same relative width and spinulation of the remaining three pairs of walking legs. Nevertheless, they are slightly shorter than the first pair (P2) and their relative length (0.9 CL) is the same or similar as in many other species of the subfamily Palicinae. It appears that the widening of the P5 is an adaptation to crawling on hard substrates. Nevertheless, at least one species of the subfamily Palicinae (*Exopalicus maculatus*) has a similar habitat but it shares slender P5 with the other members of the subfamily.

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.0-1.1	1.4-1.7	1.4-1.6	0.9
Merus length/CL	0.3-0.4	0.4-0.5	0.4-0.5	0.2-0.3
Dactylus length/Cl	0.2	0.3	0.3	0.2-0.3

The maximum size of juvenile females varies widely so that size alone does seem to determine when maturity is reached. A female as large as 26.6 x 30.0 mm (NTOU) had the narrow abdomen characteristic of juvenile females.

FIG. 46. — *Crossotonotus spinipes* (De Man, 1988): ♀ 31.5 x 35.8 mm, Ryukyu Islands, Japan, 12 m, S. NIKATANI coll. (MNHN-B 26802): dorsal view.

DE MAN (1888) described *Pleurophricus spinipes* from Ambon, Indonesia. The holotype, a "juvenile male" that was collected by J. BROCK and deposited at the Göttingen Zoological Museum under registration number 761, is apparently lost. It is not in Frankfurt (SMF), where the collection of the Göttingen Zoological Museum is now deposited, nor in either Amsterdam (ZMA) or Leiden (RMNH), where some of BROCK's material studied by DE MAN was deposited (FRANSEN *et al.*, 1997: 218).

The abundant material examined agrees with the detailed description and the illustration given of the holotype given by DE MAN (1888). The antero-lateral teeth of the holotype, however, appear much too thin and pointed but only on the left side of the carapace (DE MAN, 1888, pl. 15, fig. 1); the anterior border of the carapace has two dissimilar lobes (DE MAN, 1888, pl. 15, figs 1-1a).

Manella gardineri, described by RATHBUN (1911) from five specimens collected from the western Indian Ocean (male holotype from the Amirante Islands, 10.1 x 12.1 mm; USNM 41364), is a junior subjective synonym of *C. spinipes*. RATHBUN (1911: 241) distinguished *M. gardineri* from *C. spinipes* by citing four characters: "carapace wider, surface less hairy, projections less spinous, presence of a distinct stridulating mechanism". RATHBUN obviously based at least part of the comparison on DE MAN's illustration, which shows abnormally thin anterolateral teeth but only on the left side of the carapace (see above). The "stridulating lines", the thin, sinuous ridges observed by RATHBUN, are also evident in *C. spinipes*. One difference in the holotype is that its lateral and posterolateral tubercles are thicker and rounder than usual. This feature, however, has been found in specimens of *C. spinipes* from other Indo-west Pacific locations.

Source : MNHN, Paris

Manella brevimana was described by WARD (1933) from a relatively large male (14.1 x 16.5 mm; AM P10636) from Queensland, Australia. The specimen unquestionably belongs to *C. spinipes*. WARD compared his new species with *M. gardineri* Rathbun and *P. spinipes* (as *M. spinipes*) but the differences noted were clearly the result of individual variation, such as the relative length and shape of the teeth, spines, and granules of the carapace, and the length and ornamentation of the chelipeds. The species was named "brevimana" because the chela was "not as long as the carapace", whereas that of *M. gardineri* was longer, "about 1 1/2 times as long as carapace" (RATHBUN, 1911: 241). The total length of the propodus and dactylus of the largest cheliped of the holotype of *M. brevimana* is the same (0.6 CL) as in the holotype of *M. gardineri* (USNM 41364); the total length of the cheliped (merus, carpus, propodus, and dactylus) is 1.0 CL in the holotype of *M. brevimana* against 1.3 CL in the holotype of *M. gardineri*. RATHBUN's "length of the chela" measurement certainly referred to cheliped length, which was misinterpreted by WARD.

The abdomen of the male holotype of *M. brevimana* was described as having fused segments, but the presence of separate segments is clearly visible in the fragment still extant as well as in WARD's figure (WARD, 1933: 389, pl. 21, fig. 8). One significant difference is that there is no evidence of "stridulating ridges" in the large cheliped of the holotype, as mentioned in the description. Such a structure was also reported as absent in three males from Palau (= Belau) (TAKEDA & SHIMAZAKI, 1974: 79).

A small (5.6 x 6.3 mm) male from Ceram, Indonesia, most probably a juvenile since segments 3-6 of the abdomen were fused, was identified by MOOSA & SERÈNE as *M. brevimana*. It could not be examined but it almost certainly represents *C. spinipes* on account of the illustrations, particularly of the male first pleopod (MOOSA & SERÈNE, 1981: 54, figs 12 a-b).

SIZE. — Maximum size among specimens examined: 31.5 x 35.8 mm (female, MNHN-B 26802); 36.9 x 43.3 mm (male, MNHN-B 26803).

DISTRIBUTION. — A very wide distribution throughout the Indo-west Pacific region, the widest known so far in a palicid: Red Sea (MONOD, 1938; ZARENKOV, 1968); Seychelles, Amirante Islands, and Saya de Malha Bank (RATHBUN, 1911, as *M. gardineri*); Japan (SAKAI, 1939, 1956, 1965, 1976); South China Sea (CHEN, 1975; DAI *at al.*, 1986; DAI & YANG, 1991); Ceram (MOOSA & SERÈNE, 1981, as *M. brevimana*) and Ambon (DE MAN, 1888), Indonesia; Queensland, Australia (WARD, 1933, as *M. brevimana*); Palau (= Belau) (TAKEDA & SHIMAZAKI, 1974); Samoa (A. MILNE EDWARDS, 1873a, 1873b); Hawaiian Islands (RATHBUN, 1906; EDMONDSON, 1933, 1946, 1962). Its range is now extended to La Réunion, Sri Lanka, Cocos (Keeling) Islands, Western Australia, Viet Nam, Singapore, Timor, Papua New Guinea, the Coral Sea (New Caledonia, Chesterfield Islands, and the Chesterfield-Bellona Plateau), and Fiji (Fig. 51). It seems to be restricted to hard substrates. Of the New Caledonia stations where the type of substrate was recorded, 13 of the 17 stations where the species was collected consisted at least in part of hard bottoms such as boulders and coral. Depth: "intertidal" (SAKAI, 1974: 94) and "reef flat at low tide" (MCNEILL, 1968: 81) to 146 m (RATHBUN, 1911).

Crossotonotus ceramensis (Moosa & Serène, 1981)

Manella ceramensis Moosa & Serène, 1981: 54, figs 12 c-d, 13 b, pl. 3, fig. C.

MATERIAL EXAMINED. — **Indonesia**. *Ceram*. MARIEL KING MEMORIAL EXPEDITION: stn CP 1/8-14, Piru Bay, 03°15'S, 128°8'E, coarse sand and rubble, 26-48 m, 2.06.1970: 1 ♂ holotype 5.7 x 6.5 mm (RDC CB2735).

TYPES. — *Holotype* of *Manella ceramensis* Moosa & Serène, 1981: 1 ♂ 5.7 x 6.5 mm, MARIEL KING MEMORIAL EXPEDITION, stn CP 1/8-14 (RDC CB2735).

Paratype: 1 ♀ 7.7 x 8.5 mm (MOOSA & SERÈNE, 1981), Piru Bay, Ceram, 3°15'S, 128°8'E, coarse sand and rubble, 26-48 m, MARIEL KING MEMORIAL EXPEDITION, stn CP 1/8-14, 2.06.1970 (RDC CB2737).

TYPE LOCALITY. — Piru Bay, Ceram, Indonesia, 3°15'S, 128°8'E, coarse sand and rubble, 26-48 m.

Source : MNHN, Paris

DIAGNOSIS. — Carapace (MOOSA & SERÈNE, 1981, fig. 13a, pl. 3, fig. b) subquadrate, depressed, with large, slightly swollen areas with low bosses topped by rounded tubercles. Three very broad, straight-edged anterolateral teeth (second divided into separate portions) on each side of carapace, followed by three slightly pointed tubercles along each lateral border, 2-3 smaller, blunt tubercles along each posterolateral border; 15-17 rounded tubercles along convex posterior border separated from posterolateral border by clear junction. Supraorbital borders each with two broad, rectangular lobes with irregular borders. Four lobes along anterior border; lobes broadly round, nearly equal in size, and entire borders. Suborbital borders each with two broad, rectangular lobes bordered by long, narrow teeth. Dorsal borders of cheliped propodi each with two high and conspicuous rows of pointed to rounded tubercles; distal, inner surface of propodi and proximal border of fingers smooth in male holotype; propodus of largest cheliped very high, with lower border expanded to form J-shaped proximal edge. Dactyli of P2-4 with teeth along anterior and posterior borders; dactyli of P5 with 2-3 spines along posterior borders. Abdomen of mature males with all segments free. Male first pleopods (MOOSA & SERÈNE, 1981, figs 12c-d) with sinuous basal parts; each distal part straight, one simple tip bordered by minute spinules. Abdomen of mature females with all segments free.

DISCUSSION. — *Manella ceramensis* was described by MOOSA & SERÈNE (1981) from a small male and a slightly larger female from Ceram, Indonesia. It was differentiated from *M. spinipes* and *M. brevimana* (a junior subjective synonym of *Crossotonotus spinipes*) by several differences: the presence of a frontal border that is "entire, and with obscure or very shallow median notch", wider anterolateral teeth, rounder anterolateral border, straight posterior border with a smaller number of rounded tubercles ("teeth or lobes"), abdomen of male with distinct segments, and a different morphology of the male first pleopod (MOOSA & SERÈNE, 1981: 57). The frontal lobes are broad and rounded in the holotype (5.7 x 6.5 mm; RDC CB2735), not short and almost straight, and the posterior border is slightly convex with protuberant tubercles, not almost straight, as shown in the figure of MOOSA & SERÈNE (1981, fig. 13b). A slightly convex border is nevertheless shown in the photograph of the holotype (MOOSA & SERÈNE, 1981, pl. 3, fig. C). The use of the presence of distinct segments in the male abdomen as a difference rose from the mistaken belief that the abdomen of *M. brevimana* had fused segments (see discussion of *C. spinipes*). The differences in the male first abdomen (tip entire, small pointed "spinules" instead of distinctive spines; see MOOSA & SERÈNE, 1981, figs 12 c-d), may be the result of the small size of the holotype. Although drawn as having a single pointed tip, there is a small but distinctive second lobe as in other species of *Crossotonotus*. One difference is that in the male holotype the inner surface of the propodi and fingers of the chelipeds only have a few thick setae instead of the thick cluster of plumose setae in the males of *C. spinipes*. This may also be a consequence of size.

The unique frontal and anterolateral borders of the holotype are distinctive enough to support considering *C. ceramensis* as different from *C. compressipes* and *C. spinipes*. Nevertheless, the presumed parallel occurrence of these characters in a female collected from the same location (the female paratype, which could not be examined) and their absence in the many other specimens of *C. spinipes* that were examined in this study does not support the possibility of individual variation. The examination of the paratype as well as of additional material may provide additional evidence.

SIZE. — Size of the only two specimens known: 5.7 x 6.5 mm (male holotype, RDC CB2735), 7.7 x 8.5 mm (female paratype, MOOSA & SERÈNE, 1981).

DISTRIBUTION. — Known only from Ceram, Indonesia (MOOSA & SERÈNE, 1981). Depth: 26-48 m.

Crossotonotus lophocheir sp. nov.

Figs 47

MATERIAL EXAMINED. — **New Caledonia**. LAGON: stn 692, 21°32.0'S, 166°12.3'E, boulders and corals, 44-48 m, 9.08.1986: 1 ♀ paratype 6.0 x 6.8 mm (MNHN-B 26736).

Source : MNHN, Paris

EXPÉDITION MONTROUZIER: Touho Bank, 20°44.6'S, 165°13.7'E, suction pump, hard substrate, 15 m, 31.08.1993: 1 ♂ holotype 4.2 x 5.1 mm (MNHN-B 26733). — Koé Reef, 20°47.7'S, 165°15.7'E, diving, 10 m, 8.09.1993: 1 juv. ♀ paratype 5.4 x 6.1 mm (MNHN-B 26734), 1 ♀ paratype 5.5 x 6.2 mm (MNHN-B 26735).

TYPES. — *Holotype*: 1 ♂ 4.2 x 5.1 mm, EXPÉDITION MONTROUZIER (MNHN-B 26733).

Paratypes: 1 ♀ 6.0 x 6.8 mm, LAGON, stn 692 (MNHN-B 26736); 1 juv. ♀ 5.4 x 6.1 mm, EXPÉDITION MONTROUZIER (MNHN-B 26734); 1 ♀ 5.5 x 6.2 mm, EXPÉDITION MONTROUZIER (MNHN-B 26735).

TYPE LOCALITY. — Touho Bank, New Caledonia, 20°44.6'S, 165°13.7'E, 15 m, hard substrate.

DIAGNOSIS. — Carapace (Fig. 47a) subquadrate, depressed, with large, slightly swollen areas with low bosses. Three broad, rounded or pointed anterolateral teeth on each side of carapace, 3-4 small, blunt tubercles along each lateral border, 1-3 similar but slightly smaller tubercles along each posterolateral border; convex posterior border separated from posterolateral border by clear junction, with 10-14 small, blunt or slightly pointed tubercles. Four lobes along anterior border, inner pointed, outer lobed. Supraorbital borders each with two slightly pointed lobes. Suborbital borders (Fig. 47b) each with two lobes bifurcated into pointed tips. Dorsal borders of cheliped propodi each with one conspicuous, rounded tubercle. Dactyli of P2-5 with teeth or spines along anterior and posterior borders (2-4 on posterior borders of each P4 and P5; Fig. 47c). Abdomen of mature males with all segments free. Male first pleopods (Figs 47d-e) with sinuous basal parts; each distal part straight, two unequal tips bordered by spines. Abdomen of mature females with all segments free.

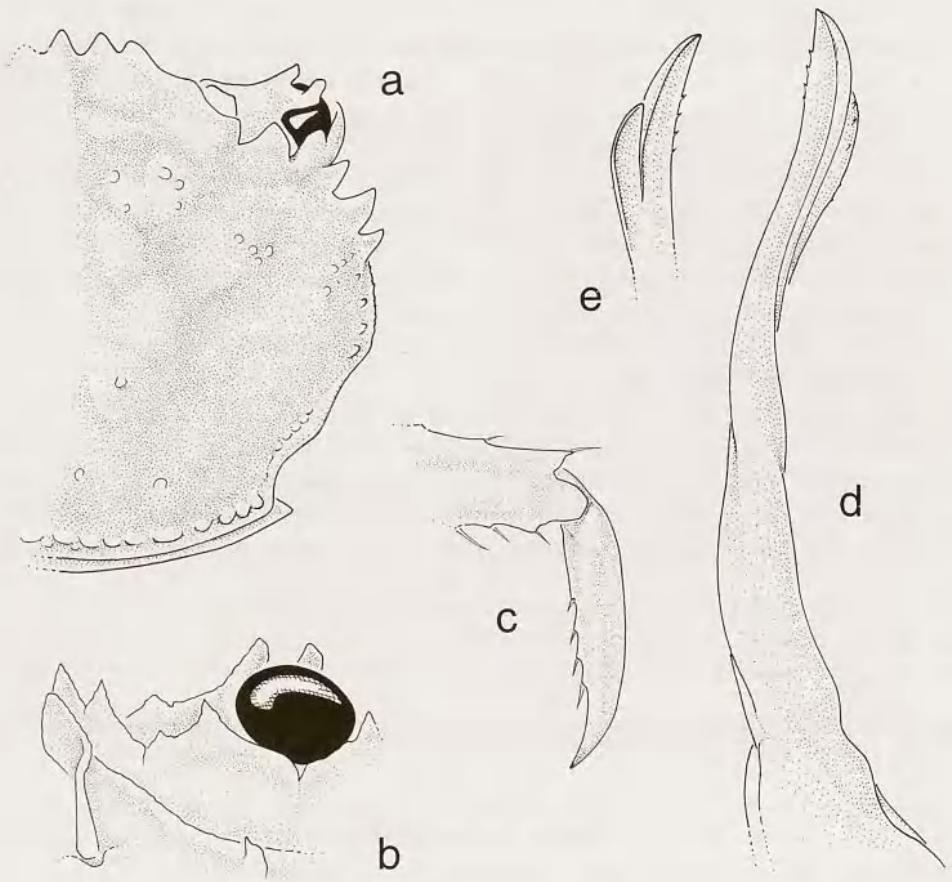


FIG. 47. — *Crossotonotus lophocheir* sp. nov., ♂ holotype, 4.2 x 5.1 mm, Touho Bank, northeast coast of New Caledonia, EXPEDITION MONTROUZIER, 15 m (MNHN-B 26733): **a**, carapace, dorsal view; **b**, suborbital border; **c**, dactylus, right fifth pereopod, dorsal view; **d**, left male first pleopod, lateral (outer side) view; **e**, left male first pleopod, apex, dorsal view.

Source : MNHN, Paris

DESCRIPTION. — Carapace (Fig. 47a) subquadrate, slightly wider than long (CW/CL = 1.1-1.2); dorsal surface depressed, covered with small granules, large, slightly swollen areas with low bosses. Confluence of branchial and mesogastric regions depressed, granular. Anterolateral borders of carapace each with three pointed or slightly rounded anterolateral teeth, first rising from base of postorbital angle. Lateral borders each with 3-4 (number increases with carapace size) small, blunt tubercles; posterolateral borders each with 1-3 similar but slightly smaller tubercles. Posterior border separated from posterolateral border by clear junction, with 10-14 blunt or slightly pointed tubercles, conspicuous plumose setae.

Frontal border of carapace divided into four lobes, inner lobes longer and more pointed. Borders between frontal lobes and supraorbital borders slightly folded upward medially, ending in sharp angle forming V- shaped fissure before supraorbital border. Supraorbital borders each with two slightly pointed lobes. Postorbital angles long (extend to slightly beyond dorsal border of retracted eye) and pointed inward. Cornea of eyes spherical, wider than base of long eye peduncle; each peduncle with two conspicuously long, granular tubercles on distal border.

Suborbital borders (Fig. 47b) each with one triangular inner lobe topped by two pointed teeth (innermost longest), one broad, rounded outer lobe topped by two teeth (innermost blunt, outermost pointed and longest). Pterygostomial lobes project slightly ventrally, slightly pointed.

Each basal antennal segment slender and rectangular; flagellum long, with very long, simple setae. Epistome very narrow, vertically inclined, with two short, pointed median teeth, each flanked by short outer process and thin, rounded margin before pterygostomial lobe. Inner border of ischia of third maxillipeds straight; surface granular, upper borders round. Meri much narrower than ischia; very small, rounded upper borders.

Dorsal borders of cheliped propodi each with one conspicuous, rounded tubercle bordered by minute teeth and 1-2 small, pointed tubercles. Fingers of largest cheliped with rounded teeth, similar teeth or cutting edge in smallest cheliped. Carpus short, each outer border with one conspicuous, rounded tubercle and several small, pointed tubercles; meri slender, outer borders with rounded and pointed tubercles.

Walking legs (P2-5) slender but without filiform propodi and dactyli. Upper and lower borders of meri with pointed tubercles of different sizes; distalmost tubercle on each anterior border much wider at base, much higher, slender, pointed, directed distally (decrease in size from P2 to P5). Anterior borders of carpi of all walking legs with small tubercles (smaller in P5); anterior and posterior borders of propodi with short teeth (thin spines along anterior borders of P5); posterior borders of dactyli with teeth, each topped with spine (two on P2, 2-3 on P3-4, three on P5), anterior borders with short teeth (3-4 long, curved spines along anterior border of dorsal side of each P5; Fig. 47c). Each P2-4 with one dorsal, carina each on carpus and propodus; each P5 with one dorsal carina on propodus. Meri, carpi, and propodi of all walking legs with plumose setae; dorsal surfaces of propodi of P3-4 each with one row of conspicuous plumose setae along anterior and posterior borders, dactyli with one similar row along each anterior border.

First pair of walking legs (P2) shorter, more slender than second and third pairs (P3-4); third pair slightly shorter than second. Fifth pair of walking legs (P5) short (0.9-1.0 CL), flattened but more slender than the anterior walking legs (P2-4).

The relative length of pereopods 2-5 among the specimens that were measured is as follows:

	P2	P3	P4	P5
Total length/CL	1.2-1.3	1.7-2.0	1.5-1.9	0.9-1.0
Merus length/CL	0.4-0.5	0.5-0.6	0.4-0.6	0.2
Dactylus length/Cl	0.2-0.3	0.4-0.5	0.3-0.4	0.2-0.3

Abdomen of mature males with all segments free. Male first pleopods (Figs 47d-e) with sinuous basal parts; each distal part straight, one pointed tip divided into two unequal parts both bordered by minute teeth. Abdomen of mature females with all segments free.

DISCUSSION. — This species is being described from only one male and three females, all of small size. The smallest female is a juvenile; the remaining two (the smallest, 5.5 x 6.2 mm) are ovigerous. It seems to be restricted, like *C. spinipes*, to hard substrates.

Source : MNHN, Paris

Other than the size difference (*C. spinipes* attains a much larger size and females become ovigerous at a much larger size), diagnostic characteristic for *C. lophocheir* are the presence of a large, rounded tubercle on the dorsal border of each cheliped propodus (two rows of relatively shorter tubercles in *C. compressipes* and *C. spinipes*), relatively longer walking legs (P3 1.7-2.0 CL in contrast to 1.4-1.7 CL in *C. spinipes*), the large cheliped of the male lacks the sinuous ridges, or presumed stridulating surface of *C. spinipes*, and the inner border of the propodi of the male chelipeds lack a dense cluster of setae.

SIZE. — Maximum size among specimens examined: 6.0 x 6.8 mm (female); 4.2 x 5.1 mm (male holotype).

ETYMOLOGY. — From *lophos*, Greek for crest or ridge, and *cheir*, Greek for hand, in reference to the characteristic crest-like tubercles on the dorsal border or the cheliped propodi and carpi.

DISTRIBUTION. — Known only from New Caledonia. Depth: 10-44 m.

Genus ***PLEUROPHRICUS*** A. Milne Edwards, 1873

Pleurophricus A. Milne Edwards, 1873a: 84. — MOOSA & SERÈNE, 1981: 53 (in key).

TYPE SPECIES. — *Pleurophricus cristatipes* A. Milne Edwards, 1873.

DIAGNOSIS. — Carapace subcircular; frontal border divided into 2-4 lobes. Anterolateral borders with pointed or rounded teeth. Dorsal surface of carapace with small granules and high, granular bosses, including two very high bosses on metagastric region. Eyes spherical, peduncles with soft tubercles. Supraorbital borders each with two lobes. Suborbital borders each with two lobes. Each basal antennal segment rectangular. Epistome very narrow. Chelipeds equal. Walking legs (P2-5) similar in shape; meri may be inflated, dactyli hook-like. Abdomen of mature males elongate (sides parallel to each other), with all segments free. Male first pleopods long, slender with basal parts straight; each distal part uniramous, tip with minute teeth. Abdomen of adult females with all segments free.

REDESCRIPTION. — Carapace subcircular, dorsal surface with granular bosses, including two very high bosses on metagastric region. Anterolateral borders each with three pointed or three secondarily bifurcated, slightly pointed teeth; posterolateral borders with slightly rounded tubercles, with marked junction with convex posterior border. Confluence of branchial and mesogastric regions depressed and smooth; no conspicuous sulcus between hepatic and branchial regions. Posterior border with 5-6 salient, rounded tubercles. Thoracic sternite 7 without episternal process visible dorsally.

Frontal border divided into 2-4 pointed or rounded lobes (if four, inner pair more advanced anteriorly than outer pair). Supraorbital borders each with two rounded lobes. Postorbital angles short, with slightly pointed tips. Cornea of eyes spherical, slightly wider than base of eye peduncle; peduncle with granular tubercles at least on distal border. Orbits deep.

Suborbital border with two broad, rounded lobes. Pterygostomial lobe at each anterolateral angle of buccal frame broad and pointed.

Each basal antennal segment rectangular. Epistome very narrow, not expanded dorsoventrally, vertically inclined. Meri of third maxillipeds smaller and narrower than ischia.

Chelipeds equal in males. Walking legs (P2-5) about same size. Meri may be inflated and dactyli hook-like.

Abdomen of mature males elongate, with both sides almost parallel to each other, with all segments free, no transverse ridges; first segment broad and long. Male first pleopods long and slender; basal part straight; distal part uniramous, with tip bordered by minute teeth. Abdomen of adult females with all segments free, no transverse ridges.

SPECIES INCLUDED. — *P. cristatipes* A. Milne Edwards, 1873 and *P. longirostris* (Moosa & Serène, 1981).

Source : MNHN, Paris

SEXUAL DIMORPHISM. — Unknown.

DISCUSSION. — *Pleurophricus* was described for *P. cristatipes* A. Milne Edwards, 1873, which until now had been known from only one specimen collected in Australia ("Nouvelle Hollande"). The genus was placed by A. MILNE EDWARDS (1873a: 260) among the Oxystomata *à côté des Orithya* (Ocypodidae). MIERS (1879: 660) included the genus (but with some doubt) in the Oxyrhyncha and HASWELL (1882: 23) listed it among the crabs of Australia under the family Maiidae. The structure of the orbits, eyes, peduncles, and carapace leave no question of its inclusion in the Palicidae, even if only two incomplete specimens have been examined.

The morphologies of the abdomen and of the male first pleopods, both absent in the holotype of *P. cristatipes*, are very close to those of *Crossotonotus spinipes*, which would support the inclusion of *Pleurophricus* in *Crossotonotus* A. Milne Edwards, 1873. Both genera were actually described in the same publication but placed among different groups of brachyuran crabs. Their descriptions, however, did not include any characters that could be used to actually differentiate between the two. The similarities were so close that the second species of *Pleurophricus* that was described (*P. spinipes* De Man, 1888) is actually a species of *Crossotonotus* (see above). Nevertheless, NOBILI (1907: 402) stated that *P. cristatipes* and *C. spinipes* (as *Pleurophricus spinipes*) did not belong to the same genus. Significant differences in the shape of the carapace (subcircular in shape, fewer and larger, salient tubercles along posterior border, two very high and conspicuous bosses on metagastric region, in contrast to the subquadrate carapace with very low bosses and many, very small tubercles along the posterior border in *Crossotonotus*) and walking legs (presumably shorter and more equal in length than in *Crossotonotus*), however, support the separation of the two genera within the Crossotonotinae.

Key to the species of *PLEUROPHRICUS*

1. Narrow, pointed anterolateral teeth; posterior border with five tubercles (Fig. 48a). Walking legs with narrow meri (A. MILNE EDWARDS, 1873a, pl. 1, fig. 6) .... ***P. cristatipes*** A. Milne Edwards, 1876

— Flattened, wider anterolateral teeth; posterior border with six tubercles (MOOSA & SERÈNE, 1981, fig. 14). Walking legs with inflated, nearly rounded meri .... ***P. longirostris*** (Moosa & Serène, 1981)

Pleurophricus cristatipes A. Milne Edwards, 1873

Figs 48

Pleurophricus cristatipes A. Milne Edwards, 1873a: 260 [84], pl. 1, figs 6, 6b, 6c. — HASWELL, 1882: 23. — RATHBUN, 1906: 837. — SERÈNE, 1968: 97. — MOOSA & SERÈNE, 1981: 60.

MATERIAL EXAMINED. — **Indonesia**. *Kai Islands. "Alpha Helix"*: stn M-99, 05°31.6'S, 132°17.8'E, 6-18 m, 7.07.1979: 1 ♂ (USNM).

Australia. 1 ♂ holotype 9.0 x 9.0 mm (ZMUH K-347).

TYPES. — *Holotype*: 1 ♂ 9.0 x 9.0 mm, originally at Godeffroy Museum, Hamburg, no. 6044 (ZMUH K-347).

TYPE LOCALITY. — Australia, unknown depth.

DIAGNOSIS. — Carapace (Fig. 48a) subcircular, with several elevated areas topped by conspicuous granular bosses (two very conspicuous bosses on metagastric region). Three pointed anterolateral teeth (first rising from base of postorbital angle) on each side of carapace, one large, pointed tubercle along each lateral border, 1-2 slightly smaller, pointed tubercles along each posterolateral border; straight posterior border separated from posterolateral border by clear junction, with five blunt, salient tubercles. Four lobes along anterior border; rounded

Source : MNHN, Paris

median lobes slightly longer than rounded outer lobes. Supraorbital borders each with two rounded lobes. Suborbital borders (Fig. 48b) each with two slightly pointed lobes, inner fused to pterygostomial lobe. Dorsal borders of cheliped propodi each with two rounded tubercles (A. MILNE EDWARDS, 1873a, pl. 1, fig. 6). First three walking legs nearly equal in size (A. MILNE EDWARDS, 1873a, pl. 1, fig. 6). Abdomen of mature males with all segments free. Male first pleopods with straight basal parts; each distal part straight, with simple tip. Females unknown.

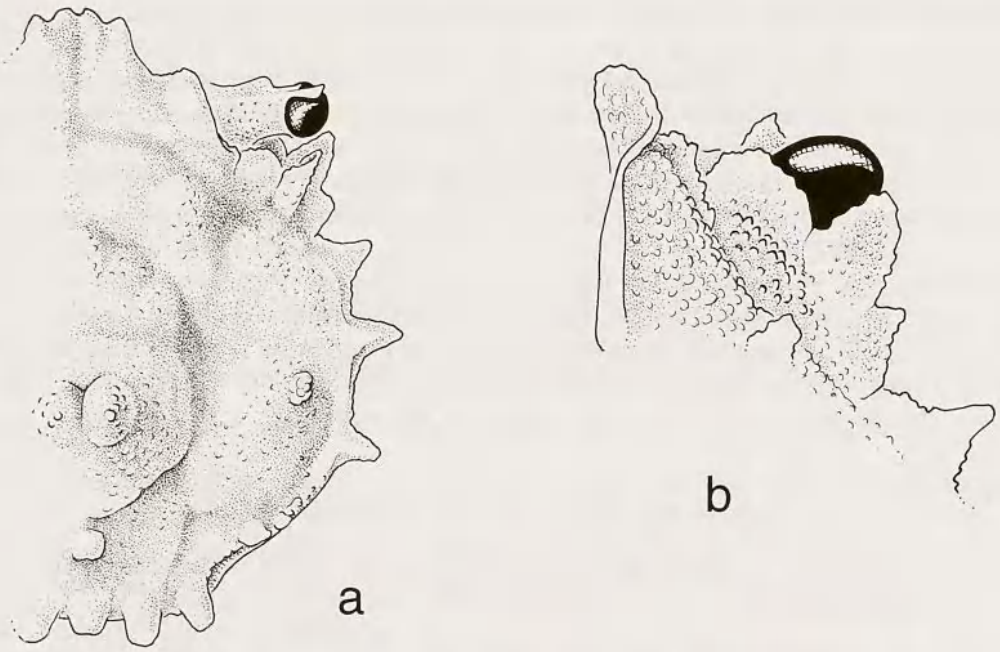


FIG. 48. — *Pleurophricus cristatipes* A. Milne Edwards, 1873, ♂ holotype, 9.0 x 9.0 mm, Australia, unknown depth (ZMUH K-347): **a**, carapace, dorsal view; **b**, suborbital border.

DISCUSSION. — The type material of *P. cristatipes*, a male (9.0 x 9.0 mm; ZMUH K-347), is unfortunately incomplete. While the dorsal surface and the anterior portion of the ventral surface of the carapace are complete (Figs 48a-b), the remaining portions of the ventral surface survive as two large pieces, and the walking legs and chelipeds are missing. The figure given in the description (A. MILNE EDWARDS, 1873a, pl. 1, fig. 6) showed that the first pair of walking legs is not reduced and that the last pair is only slightly reduced in size in comparison to the other legs. The walking legs were described as having an "unequal crest" (*crête inégale*). The chelipeds were shown as nearly identical (raising some doubts on the accuracy of the figure). Both were heavy, with two large tubercles on the dorsal surface of each propodus.

One very small, soft, and incomplete (no appendages) male from the Kai Islands (Banda Sea) Indonesia (2.4 x 2.4 mm; USNM) proved to be identical to the holotype of *P. cristatipes* as far as the shape of the carapace is concerned (number, shape, and position of teeth and tubercles, morphology of the anterior, posterior, and supraorbital borders). The coxae of the fourth walking legs, as in *P. cristatipes*, were aligned with the coxae of the anterior walking legs. The abdomen of the Banda Sea specimen had all segments free. The male first pleopods (soft in the specimen) appeared to have a straight basal part. The distal part was straight, with a simple tip very much as in *C. spinipes* and *C. lophocheir*. The presence of abdominal segments that were all free strongly suggests that the male was mature.

SIZE. — Maximum size among the two specimens examined: 9.0 x 9.0 mm (male holotype; ZMUH K-347).

DISTRIBUTION. — Known only from Australia ("Nouvelle Hollande"; A. MILNE EDWARDS, 1873a) and the Kai Islands, Banda Sea, Indonesia. Depth: 6-18 m.

Source : MNHN, Paris

Pleurophricus longirostris (Moosa & Serène, 1981)

Manella longirostris Moosa & Serène, 1981: 58, fig. 14.

MATERIAL EXAMINED. — **Indonesia**. *Sunda Strait.* Off Panjang Island, 16.03.1963: 1 ♀ 4.6 x 4.6 mm (RDC CB2712).

TYPES. — *Holotype*: 1 ♀ 4.6 x 4.6 mm, 16.03.1963 (RDC CB2712).

TYPE LOCALITY. — Off Panjang Island, Sunda Strait (between Sumatra and Java), Indonesia.

DIAGNOSIS. — Carapace (MOOSA & SERÈNE, 1981, fig. 14) hexagonal, depressed, with swollen areas with bosses topped by rounded tubercles. Four broad, slightly pointed anterolateral teeth on each side carapace, two large, pointed teeth along each lateral border; slightly convex posterior border separated from posterolateral border by clear junction, six rounded, low tubercles. Two narrow, squarish lobes along anterior border. Supraorbital borders each with two very short, rounded lobes. Suborbital borders each with two lobes, one with triangular, pointed tip, second obliquely directed with irregular border. Dorsal border of cheliped propodi with cusp of pointed tubercles. Meri of walking legs inflated, laterally flattened, almost circular. Dorsal borders of meri and carpi with thin, rounded tubercles. Dactyli short, hook-like, one spine on each posterior border. Males unknown. Abdomen of mature females with distinct segments.

DISCUSSION. — The species was described from one small ovigerous female collected in the Sunda Strait, Indonesia (MOOSA & SERÈNE, 1981). It was included in *Manella*, a junior subjective synonym of *Crossotonotus* (see above). It is tentatively placed in *Pleurophricus* since its carapace is very similar in shape to that of *P. cristatipes* (Fig. 48a). There are differences between the species, however. The most obvious is in the presence in the walking legs of *P. longirostris* of inflated, almost circular meri bordered by thin, rounded tubercles in contrast to the thin meri of *C. cristatipes* (A. MILNE EDWARDS, 1873a, pl. 1, fig. 6). They were described as "very inflated which give the impression of a tree leaf" (MOOSA & SERÈNE, 1981: 58). The flattened meri, hook-like dactyli, and the very long plumose setae on the meri, carpi, and particularly on the propodi suggest that the species may be cryptic and perhaps associated with the surface of algae or another organism.

Other differences are in the shape of the anterolateral teeth. They are flattened, secondarily divided, and less pointed (very much as in *C. spinipes*) in *P. longirostris*, while they are narrower and more pointed in *P. cristatipes* (Fig. 48a). There are six rounded tubercles along the posterior border of *P. longirostris* but five pointed tubercles in *P. cristatipes* (Fig. 48a).

The relative length and shape of the fifth pair of walking legs (P5) are unknown. They articulate to the carapace at the same level as the other walking legs as in other members of the Crossotonotinae.

SIZE. — Size of female holotype: 4.6 x 4.6 mm.

DISTRIBUTION. — Only known from Panjang Island, Sunda Strait, Indonesia. Depth: unknown.

ECOLOGY AND OTHER ASPECTS OF THE BIOLOGY OF THE INDO-WEST PACIFIC PALICIDS

HABITAT. — Most species of palicids appear to be restricted to mud, sand, and other soft sediments at moderate depths. This is the case of species of *Pseudopalicus*, *Parapalicus*, *Miropalicus*, *Paliculus*, and *Rectopalicus* in the Indo-west Pacific and of *Palicus* in the Mediterranean, Atlantic, and eastern Pacific. Species of *Neopalicus* and *Palicoides* are known only from coarse, biogenous sediments in shallow water around Indo-west Pacific coral reefs. Species of *Exopalicus*, *Crossotonotus*, and apparently *Pleurophricus*, are inhabitants of hard bottoms in shallow water.

Source : MNHN, Paris

Species of *Parapalicus* and *Miropalicus* (plus *Pseudopalicus macromeles* and *Paliculus kyusyuensis*) have long, slender legs that seem to be adapted to slide over muddy sediments. At least this is what has been observed in freshly collected live specimens of *Parapalicus* (B. RICHER DE FORGES, personal communication). There is no information on the microhabitats and habits of the other palicids that live on soft sediments but that have flattened walking legs (species of *Pseudopalicus* and *Rectopalicus*) other that the legs appear to be adaptations for occasional swimming. This possibility is supported by observations of live *P. amadaibai* using its second and third pairs of walking legs for active swimming off the sandy bottom of an aquarium (T. KOMAI, personal communication).

The high bosses and tubercles on the carapace of most palicids do not support the possibility that any of the species inhabiting soft sediments are long-term borrowers in the sediment itself. This, however, may not be the case of species of *Neopalicus* and *Palicoides*, inhabitants of coarse sediments in coral reefs. Their carapaces are relatively smooth, being devoid of high bosses. Their habits, however, remain unknown.

There is no detailed information on the microhabitats and habits of palicids living on hard substrates. Many of the few records of *Exopalicus maculatus* have been from collections during night diving, a suggestion that they hide in coral and other hard substrates during daytime.

Most of the species inhabiting soft sediments have been collected from moderate depths in the subtidal and bathyal zones (Table 5): *Pseudopalicus* (30-430 m), *Parapalicus* (55-778 m), *Miropalicus* (245-575 m), *Paliculus* (50-487 m), and *Rectopalicus* (105-430 m). Exceptions are the species inhabiting coarse sediments in coral reefs: *Neopalicus* (10-146 m) and *Palicoides* (6-73 m). Inhabitants of hard substrates are also restricted to shallow water: *Exopalicus* ("shallow water" to 18 m) and *Crossotonotus* ("intertidal" to 146 m). Nothing is known about the habitat of the two little-known species of *Pleurophricus* but they appear to be inhabitants of hard bottoms in shallow water (only record for *P. cristatipes*, 6-18 m).

BIOGEOGRAPHY. — Information on the geographic distribution of Indo-west Pacific palicids is limited and incomplete. The majority are deep-water, cryptic, or nocturnal species that are rarely collected or seen. Most of the information (as well as most of the new species described here) are from the Coral Sea and southwestern Pacific, where recent collecting effort has been more intense (Table 6). Conversely, little is known about the distribution of palicids through most of the Indian Ocean and the central Pacific.

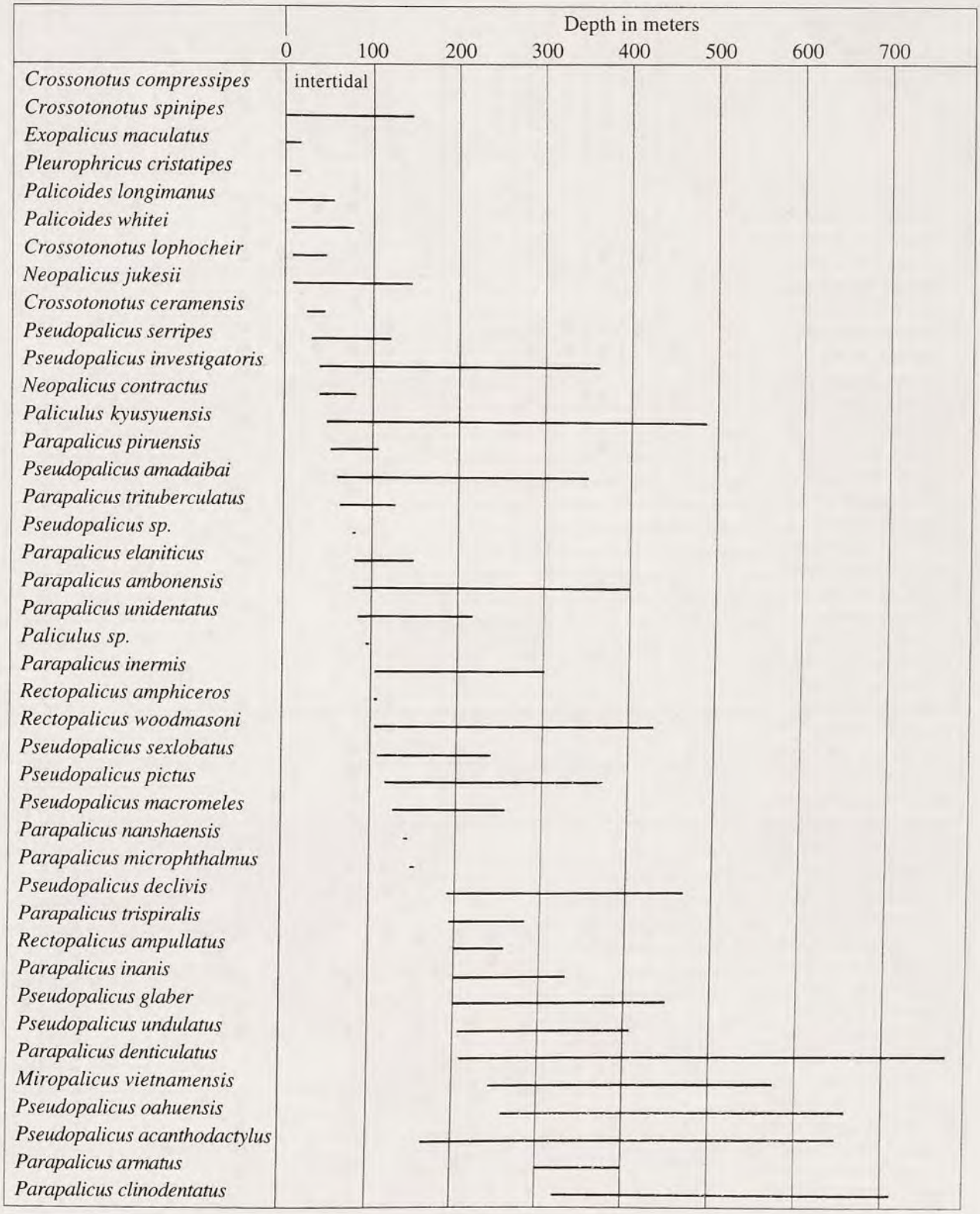
There is no evidence of the occurrence of any palicids in the Indian or Pacific oceans outside the tropical Indo-west Pacific region proper. Species of *Palicus*, however are found in subtropical or temperate waters outside the tropics in the Mediterranean and off the northwestern coast of Africa [*P. caronii* (Roux, 1830)], the eastern coast of North America north of northern Florida and/or the eastern coast of South America south of Rio de Janeiro [*P. alternatus* (Rathbun, 1897), *P. cursor* (A. Milne Edwards, 1880), *P. dentatus* (A. Milne Edwards, 1880), *P. faxoni* Rathbun, 1897, *P. gracilis* (Smith, 1883), *P. obesus* (A. Milne Edwards, 1880)], and the Gulf of California [*P. cortezi* (Crane, 1937), *P. fragilis* (Rathbun, 1893), *P. lucasii* Rathbun, 1898 and *P. zonatus* (Rathbun, 1893)]. Most of these species, however, are also found in tropical regions (see RATHBUN, 1918; MELO, 1996).

The most widely distributed species that show a wide Indo-west Pacific distribution are inhabitants of shallow water: *Neopalicus contractus* and *N. jukesii* (Fig. 49), *Palicoides longimanus* and *P. whitei* (Fig. 50), *Crossotonotus spinipes* (Fig. 51), and *Exopalicus maculatus* (Fig. 56). Although shallow-water species are the easiest to collect, some inhabitants of deeper water also show a wide Indo-west Pacific distribution. This is the case of *Pseudopalicus investigatoris*, *P. serripes* (Fig. 52), and *Paliculus kyusyuensis* (Fig. 56). None of the Indo-west Pacific species is known to cross the East Pacific barrier. The six species of palicids found in the eastern Pacific appear to be endemics to the region.

Most species of *Pseudopalicus* (Figs 52-55), *Parapalicus* (Figs 57-58), *Miropalicus* (Fig. 59), and *Rectopalicus* (Fig. 53) show a more restricted geographic distribution, mostly along the western Pacific Ocean. This is perhaps best explained as a result of collection that has been mostly limited to these areas. Restriction to particular substrates or differences in the length of larval development or the behavior of the free-living larvae, however, may effect the geographic distribution of these species.

Source : MNHN, Paris

TABLE 5. — Depth distribution (reliable ranges only) of Indo-west Pacific palicids.



Source : MNHN, Paris

TABLE 6. — Geographic distribution of Indo-west Pacific palicids.

	Red Sea	Seychelles	SW Indian Ocean	Maldives	NE Indian Ocean	W Australia	South China Sea	Japan	Philippines Is	Indonesia	Papua New Guinea	NE Australia	SE Coral Sea (1)	Fiji	Wallis and Futuna Is	Samoa	Marshall Is	Hawaiian Is	French Polynesia
Crossotonotus ceramensis										●									
Crossotonotus compressipes								●		●	●	●	●			●			
Crossotonotus lophocheir													●						
Crossotonotus spinipes	●	●	●		●		●	●		●	●	●	●	●				●	
Exopalicus maculatus			●															●	
Miropalicus vietnamensis							●			●			●						
Neopalicus contractus		●	●	●	●				●				●				●		
Neopalicus jukesii	●		●	●	●		●		●	●	●	●	●						
Palicoides longimanus								●		●			●				●		
Palicoides whitei	●	●	●		●			●		●		●	●						
Paliculus foliatus													●						
Paliculus kyusyuensis			●					●		●			●		●				
Paliculus sp									●										
Parapalicus ambonensis					●					●			●		●				
Parapalicus armatus													●						
Parapalicus clinodentatus													●	●					
Parapalicus denticulatus													●						
Parapalicus elaniticus	●		●																
Parapalicus inanis													●						
Parapalicus inermis														●					
Parapalicus microphthalmus			●																
Parapalicus nanshaensis							●												
Parapalicus piruensis									●	●			●	●					
Parapalicus trispiralis									●				●						
Parapalicus trituberculatus							●			●									
Parapalicus unidentatus							●			●									
Pleurophricus cristatipes										●		●							
Pleurophricus longirostris										●									
Pseudopalicus acanthodactylus													●						
Pseudopalicus amadaibai								●	●	●			●	●					
Pseudopalicus declivis									●	●			●						
Pseudopalicus glaber													●						
Pseudopalicus investigatoris			●		●	●	●	●	●				●	●				●	
Pseudopalicus macromeles						●													
Pseudopalicus oahuensis										●		●	●					●	●
Pseudopalicus pictus													●						●
Pseudopalicus serripes		●			●			●		●		●	●		●				
Pseudopalicus sexlobatus			●																
Pseudopalicus sp.								●											
Pseudopalicus undulatus								●	●	●			●	●					
Rectopalicus amphiceros													●						
Rectopalicus ampullatus													●		●				
Rectopalicus woodmasoni					●		●	●		●			●						
Total number of species	4	4	10	2	8	2	8	11	9	20	3	7	29	7	4	1	2	4	2

(1) SE Coral Sea includes New Caledonia, Loyalty Is, Chesterfield Is, Vanuatu.

Source : MNHN, Paris

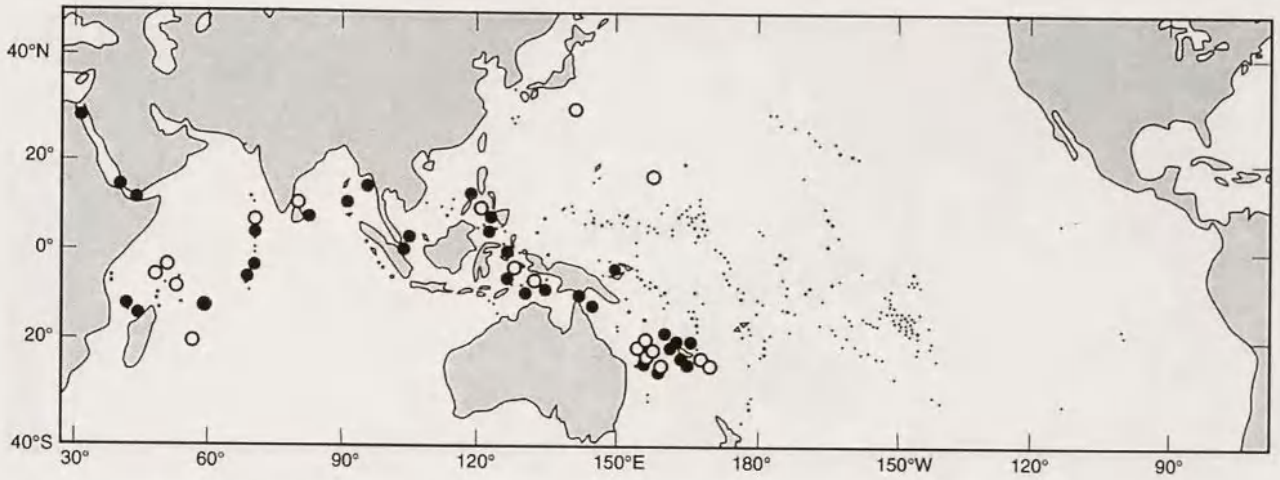


FIG. 49. — Geographic distribution of (○) *Neopalicus contractus* (Rathbun, 1902) and (●) *N. jukesii* (White, 1857).

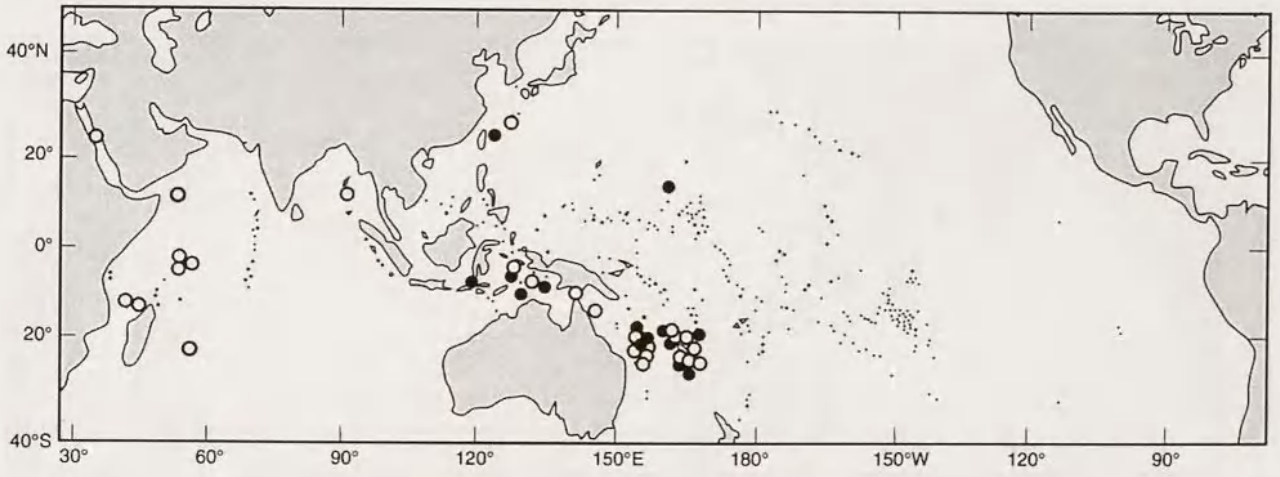


FIG. 50. — Geographic distribution of (●) *Palicoides longimanus* (Miyake, 1936) and (○) *P. whitei* (Miers, 1884).

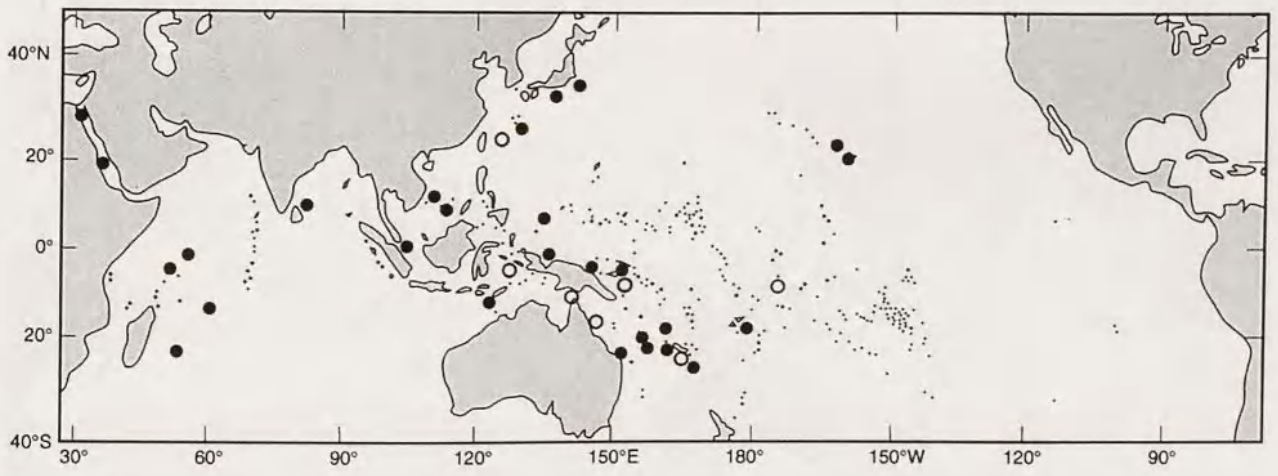


FIG. 51. — Geographic distribution of (●) *Crossotonotus spinipes* (De Man, 1888) and (○) *C. compressipes* A. Milne Edwards, 1873.

Source : MNHN, Paris

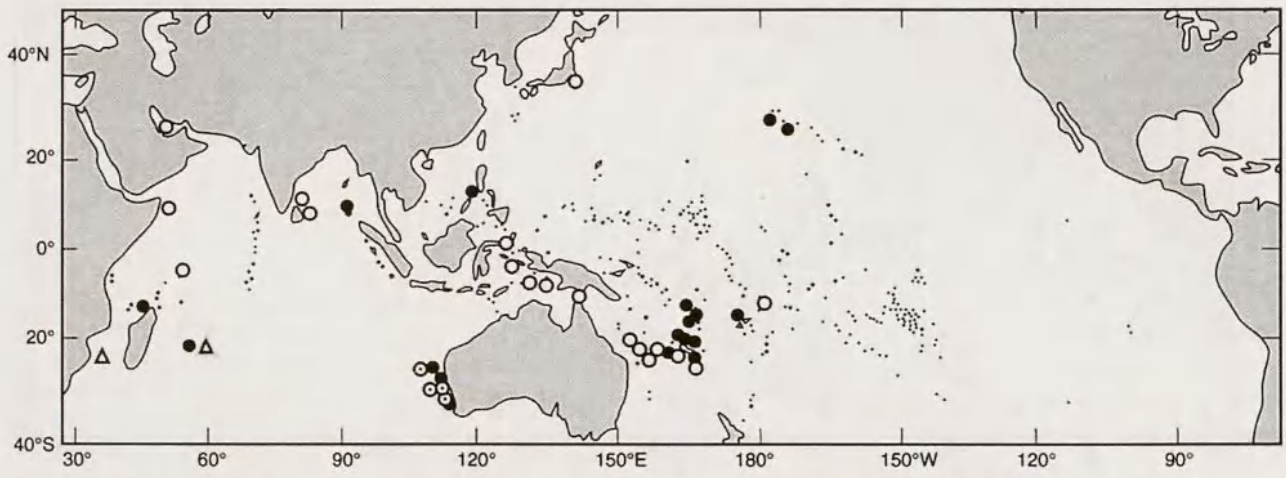


FIG. 52. — Geographic distribution of (●) *Pseudopalicus investigatoris* (Alcock, 1900), (⊙) *P. macromeles* sp. nov., (○) *P. serripes* (Alcock & Anderson, 1895), and (△) *P. sexlobatus* (Kensley, 1969).

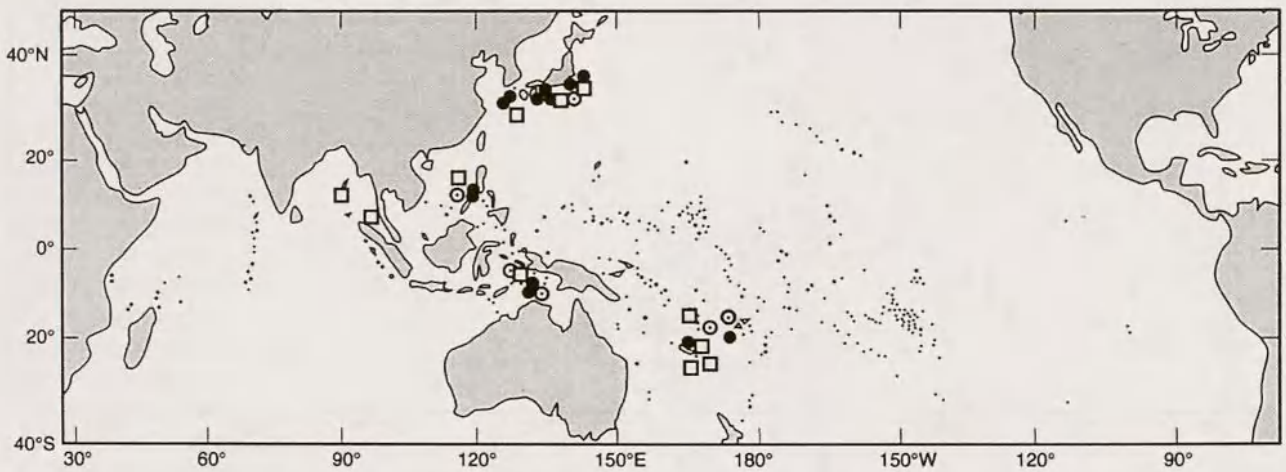


FIG. 53. — Geographic distribution of (●) *Pseudopalicus amadaibai* (Sakai, 1963), (⊙) *P. undulatus* sp. nov., and (□) *Rectopalicus woodmasoni* (Alcock, 1900).

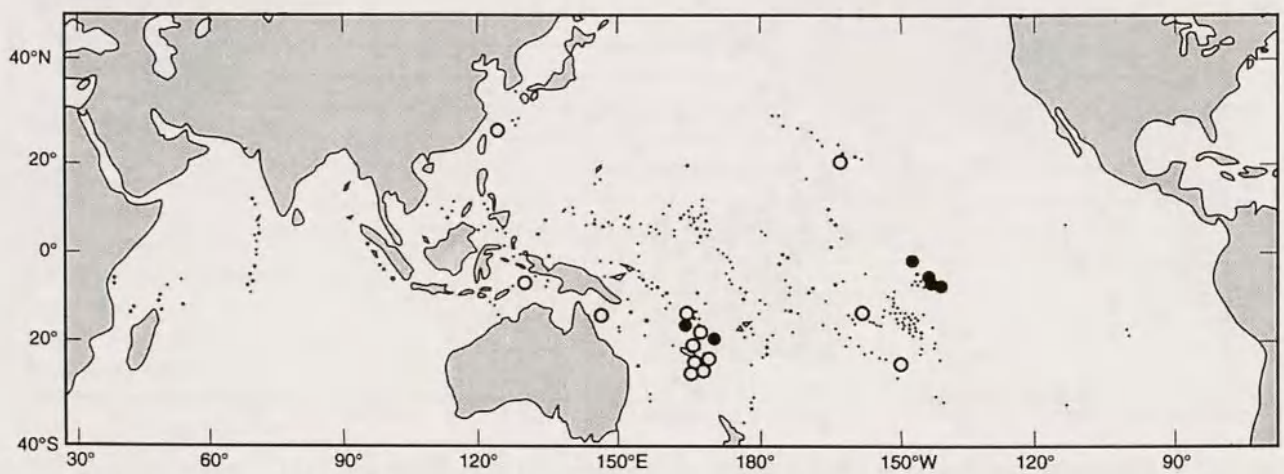


FIG. 54. — Geographic distribution of (○) *Pseudopalicus oahuensis* (Rathbun, 1906) and (●) *P. pictus* sp. nov.

Source : MNHN, Paris

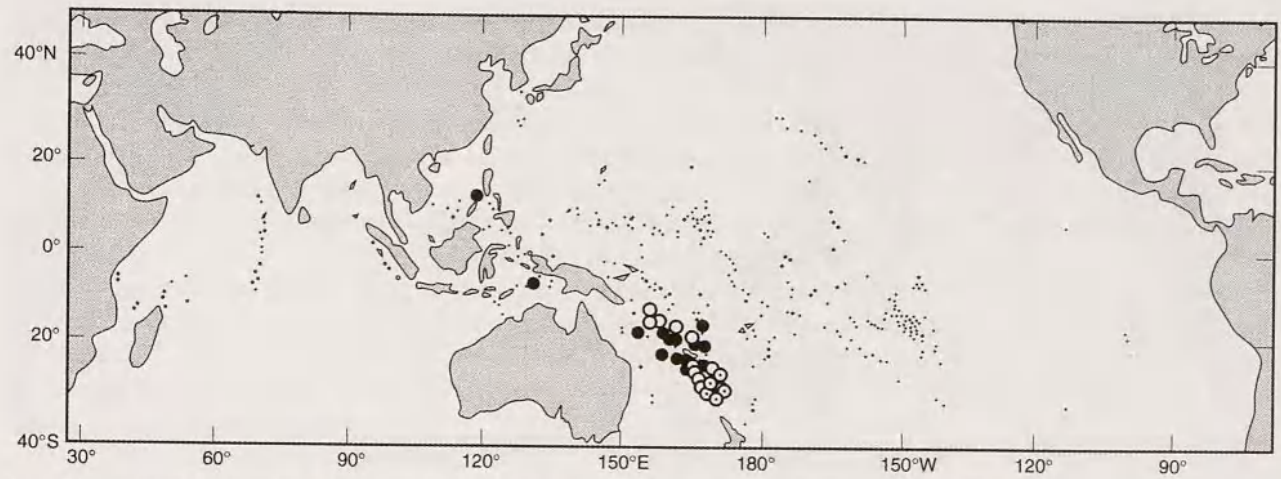


FIG. 55. — Geographic distribution of (⊙) *Pseudopalicus acanthodactylus* sp. nov., (●) *P. declivis* sp. nov., and (○) *P. glaber* sp. nov.

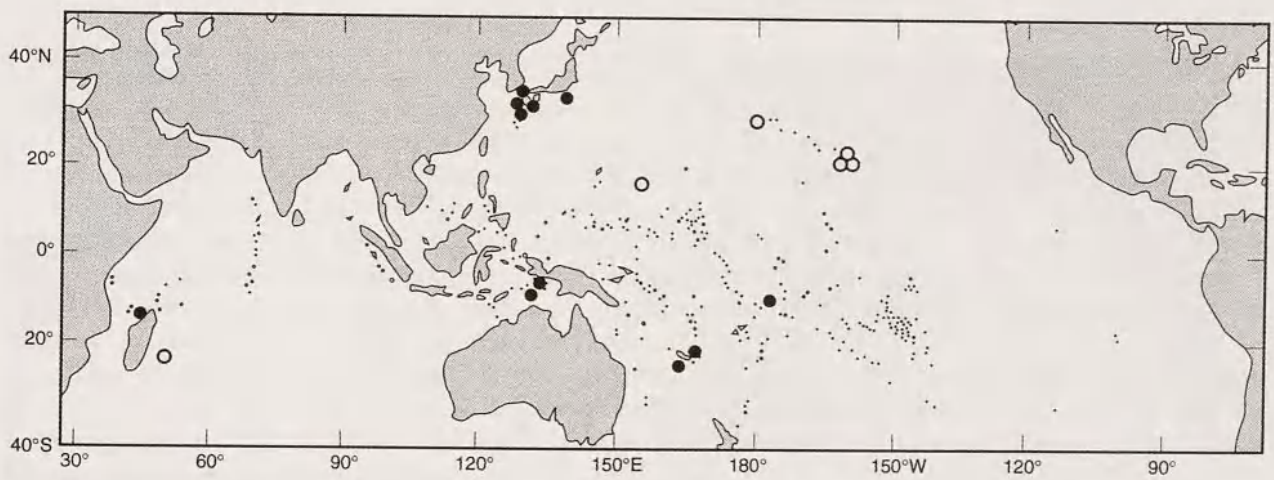


FIG. 56. — Geographic distribution of (●) *Paliculus kyusyuensis* (Yokoya, 1933) and (○) *Exopalicus maculatus* (Edmondson, 1930).

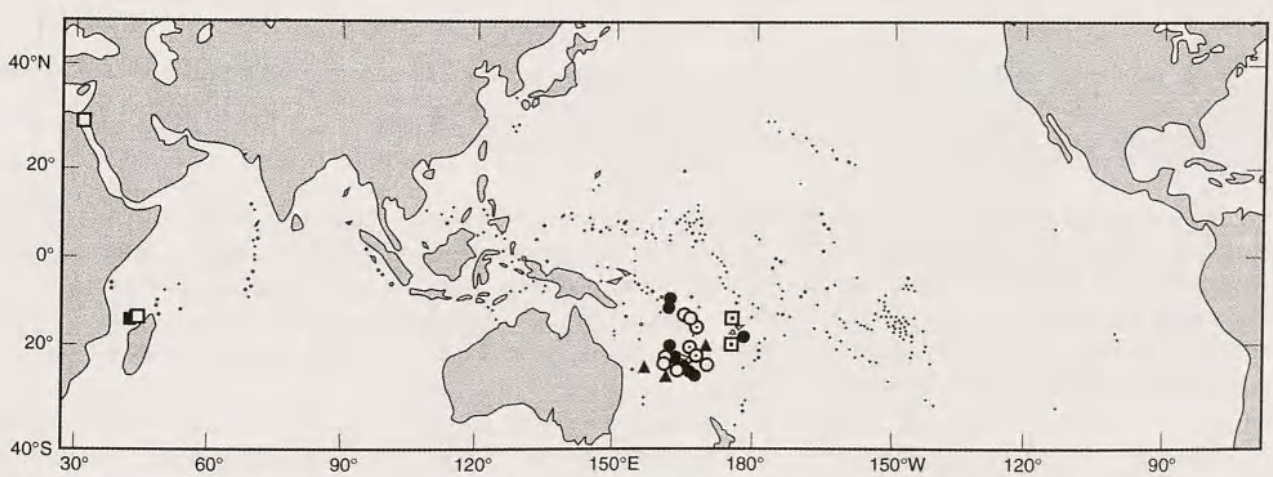


FIG. 57. — Geographic distribution of (⊙) *Parapalicus armatus* sp. nov., (●) *P. clinodentatus* sp. nov., (○) *P. denticulatus* sp. nov., (□) *P. elaniticus* (Holthuis, 1977), (▲) *P. inanis* sp. nov., (□) *P. inermis* sp. nov., and (■) *P. microphthalmus* sp. nov.

Source : MNHN, Paris

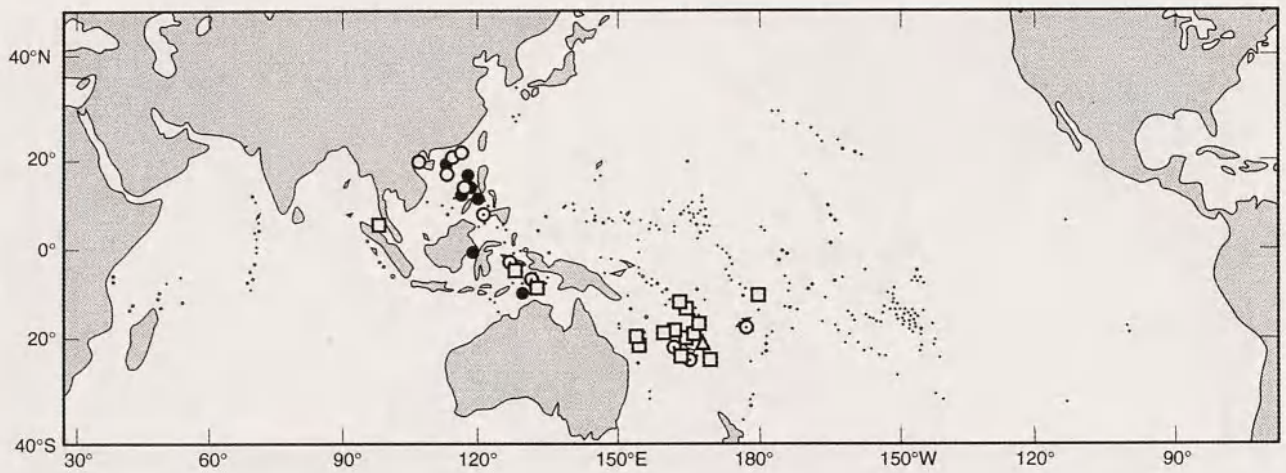


FIG. 58. — Geographic distribution of (□) *Parapalicus ambonensis* sp. nov., (⊙) *P. piruensis* Moosa & Serène, 1981, (△) *P. trispiralis* sp. nov., (○) *P. trituberculatus* (Chen, 1981), and (●) *P. unidentatus* (Zarenkov, 1968).

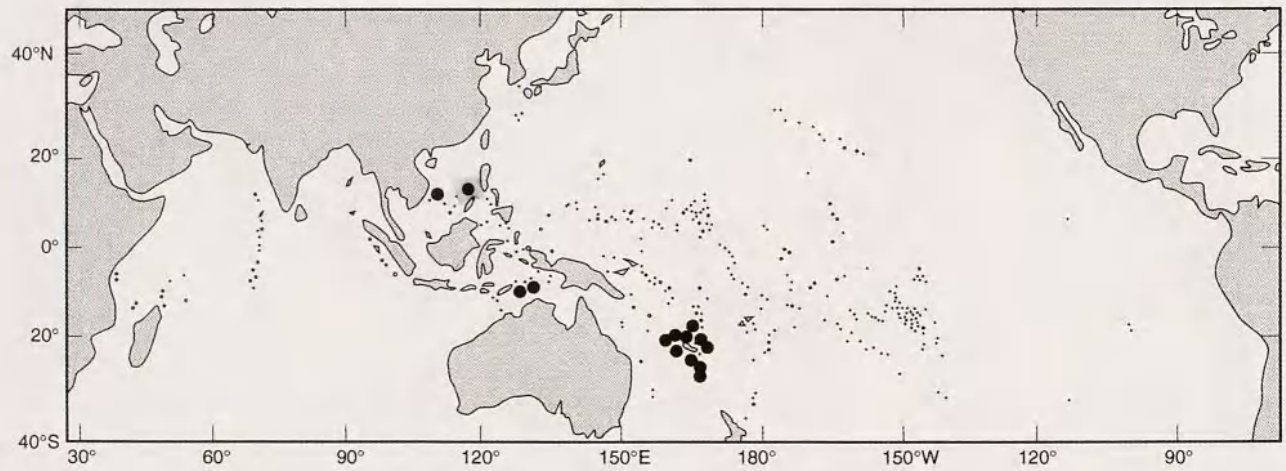


FIG. 59. — Geographic distribution of (●) *Miropalicus vietnamensis* (Zarenkov, 1968).

DIET. — Casual analyses of stomach and intestinal contents showed that palicids ingest sediment and digest particulate organic matter in it. This applies to inhabitants of soft sediments as well as those assumed to live on hard substrates such as *Exopalicus maculatus* and *Crossotonotus spinipes*.

SEXUAL DIMORPHISM AND MATING BEHAVIOR. — The presence of more unequal and much thicker or longer chelipeds in the males of many species plus the conspicuous presence of setae on the inner, distal surface of male chelipeds in six Indo-west Pacific species (*Pseudopalicus serripes*, *Exopalicus maculatus*, *Neopalicus jukesii*, *Palicoides longimanus*, *P. whitei*, and *C. spinipes*) suggests the role of chelipeds in mating behavior. The sinuous ridges found along the ventral border of the largest cheliped in the males of *C. spinipes* were suggested to serve as a stridulating structure by RATHBUN (1911: 241).

ROLE OF THE FIFTH PAIR OF PEREOPODS. — The biological significance of the reduced and slender fifth pair of pereopods characteristic of members of the subfamily Palicinae remains a mystery. The structure of the reproductive system of palicids is one characteristic of the less primitive families of Brachyura so that reduced P5 should not be considered a primitive, less specialized character.

Source : MNHN, Paris

No observations have been made of the behavior of the P5 in live palicids. There are no differences in the morphology or size of the fifth pair of pereopods between males and females so they do not appear to be involved in mating behavior. It can be hypothesized that they may be involved in cleaning the carapace and/or other appendages. The joints of the P5 are unusually mobile, and the shortening of the articles certainly increases the overall flexibility of the appendage. The movement of the various joints alternates between the dorsoventral and antero-posterior planes beginning with the dorsoventral plane of movement of the sternal-coxal articulation. The total length of the P5 is surprisingly similar in most of the species that were examined, varying between 0.7-0.9 CL with very few exceptions. This length would be just enough to reach the orbits and clean them of debris. The same relative length of the P5, however, also applies to members of the subfamily Crossotonotinae, where the P5 are broad and appear to be locomotory in function. The dactyli of P5 among members of the subfamily Palicinae are variously provided with short teeth and/or setae, typically of the simple type. Only the rows of thick, bristle-like spines that are present along the posterior border of the propodi in *Neopalicus* and *Palicoides* offer a potentially efficient cleaning surface.

WICKSTEN (1986: 365) suggested that the reduced P5 of palicids, retroplumids, and pinnotherids may be involved in climbing in burrows or in cleaning the carapace. There is no evidence that palicids are borrowers, although this remains a possibility. Nevertheless, the suggested involvement of the P5 in the cleaning of the carapace is not supported by the frequent presence of sediment or polychaete tubes on the carapace and even around the eye (Fig. 12e).

The absence of chelate or subchelate dactyli does not preclude their use in actively carrying another organism or object. Carrying behavior in many brachyurans, however, involves modified appendages unlike those of palicids (see GUINOT *et al*, 1995). There is unfortunately no evidence of carrying behavior among palicids with reduced P5. It is possible, however, that individuals carry shells or fragments of shells that are lost during collection.

Although still reduced in size, the P5 of members of the subfamily Crossotonotinae have the same morphology and insertion to the carapace as the anterior walking legs. All members of the subfamily (species of *Crossotonotus* and *Pleurophricus*) appear to be restricted to hard substrates so in these species the P5 are adapted, possibly secondarily, to an ambulatory function. Nevertheless, the P5 of *Exopalicus*, which also appears to be restricted to hard substrates, remain slender as in the inhabitants of soft substrates.

Another possible explanation for the reduction in the size of the P5 is that they have no specific function. They may thus represent vestigial structures, at least in the Palicinae. An analogous reduction in the size of the P5 is observed among brachyuran crabs of the families Hexapodidae and Retroplumidae. The affinities between palicids and these two families remain unknown.

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Source : MNHN, Paris

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FIGURE 60

a, *Pseudopalicus acanthodactylus* sp. nov., ♂ holotype, 8.9 x 10.5 mm, Norfolk Ridge, south of New Caledonia, SMIB 8, stn DW 146, 514-522 m (MNHN-B 26672): dorsal view. Photo by J.-L. MENOU, IRD.

b, *Pseudopalicus glaber* sp. nov., ♀ 8.4 x 10.6 mm, off southeast coast of New Caledonia, SMIB 4, stn DW 57, 260 m (MNHN-B 26812): dorsal view. Photo by P. LABOUTE, IRD.

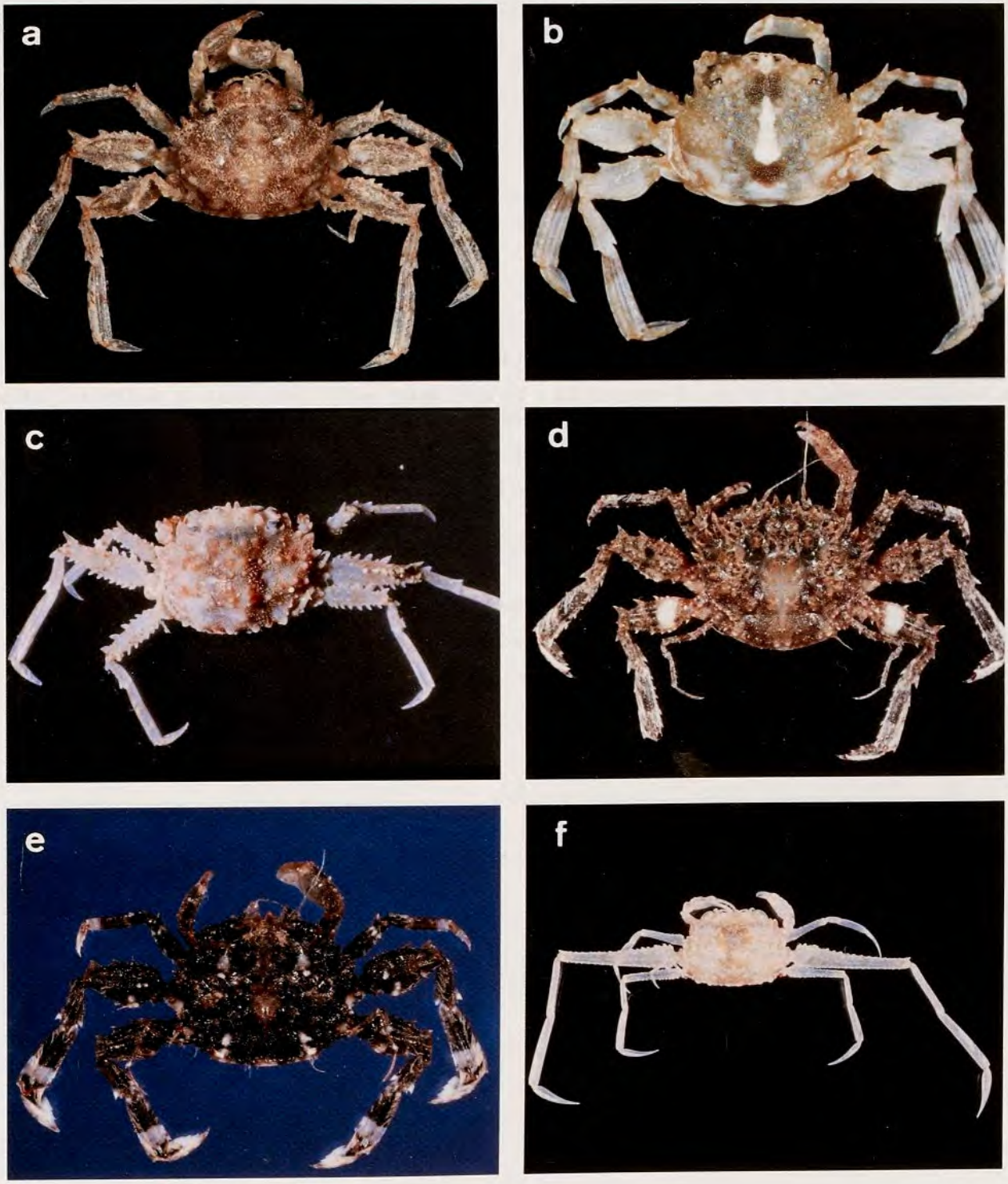
c, *Pseudopalicus oahuensis* (Rathbun, 1906), juvenile ♀ 8.2 x 10.7 mm, Norfolk Ridge, south of New Caledonia, CHALCAL 2, stn DW 75, 600 m (MNHN-B 26813): dorsal view. Photo by P. LABOUTE, IRD.

d, *Pseudopalicus investigatoris* (Alcock, 1900), ♀ 11.7 x 14.5 mm, Vanuatu, MUSORSTOM 8, stn CP 1077, 180-210 m (MNHN-B 26746): dorsal view. Photo by J.-L. MENOU, IRD.

e, *Pseudopalicus pictus* sp. nov., ♂ holotype, 8.6 x 10.4 mm, Vanuatu, MUSORSTOM 8, stn DW 1042, 200-265 m (MNHN-B 26690): dorsal view. Photo by J.-L. MENOU, IRD.

f, *Miropalicus vietnamensis* (Zarenkov, 1968), Loyalty Islands, MUSORSTOM 6, stn SW 410, 490 m (lost specimen): dorsal view. Photo by P. LABOUTE, IRD.

Source : MNHN, Paris



Source : MNHN, Paris

FIGURE 61

a, *Rectopalicus ampullatus* sp. nov., ♂ holotype, 6.2 x 6.3 mm, Loyalty Islands, MUSORSTOM 6, stn DW 462, 200 m (MNHN-B 26782): dorsal view. Photo by P. LABOUTE, IRD.

b, *Exopalicus maculatus* (Edmondson, 1930), Makaha, Oahu, Hawaiian Islands, 6 m: dorsal view. Photo by J. HOOVER.

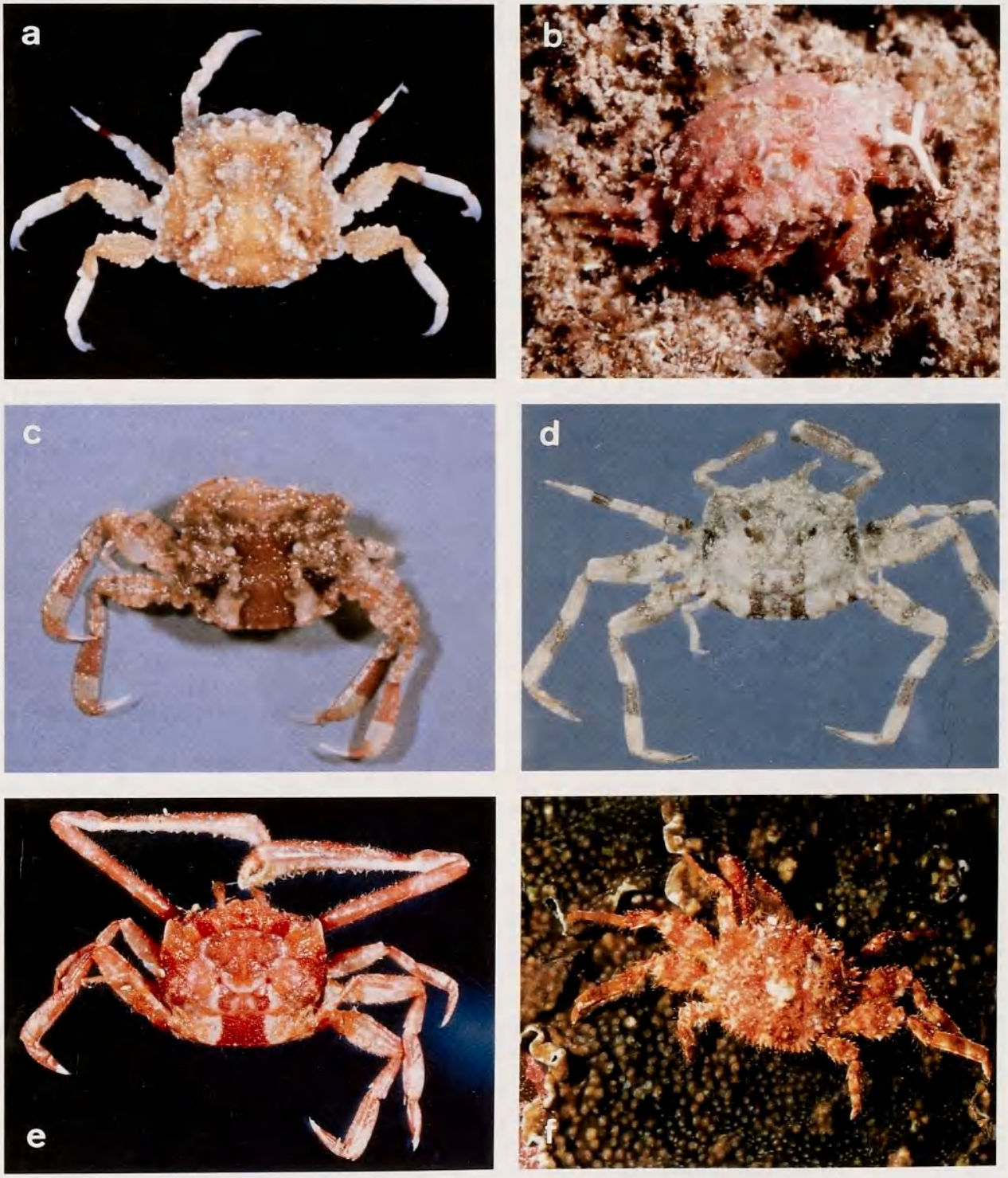
c, *Neopalicus jukesii* (White, 1847), ♂ 6.0 x 7.1 mm, New Caledonia, LAGON, stn 702, 37 m (MNHN-B 26814): dorsal view.

d, *Palicoides longimanus* (Miyake, 1936), ♂ 9.6 x 11.2 mm, New Caledonia, LAGON, stn 952, 16-17 m (MNHN-B 26794): dorsal view.

e, *Palicoides whitei* (Miers, 1884), ♂ CL 14.5 mm, New Caledonia, LAGON, stn 748, 35 m (MNHN-B 26801).

f, *Crossotonotus spinipes* (De Man, 1888), ♂ 36.9 x 43.3 mm, New Caledonia, 12 m (MNHN-B 26803).

Source : MNHN, Paris



Source : MNHN, Paris

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Source : MNHN, Paris

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Source : MNHN, Paris

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ADDENDUM

Specimens of Palicidae collected in Fiji by the BORDAU 1 and SUVA 2 expeditions were examined while this paper was in press. The specimens are listed below. Seven of the ten species listed (printed in bold) are new records for Fiji.

Miropalicus vietnamensis (Zarenkov, 1968): BORDAU 1, stn CP 1411, 16°05'S, 179°28'W, 390-403 m: 1 juv. ♀ (MNHN-B 27650). — Stn CP 1434, 17°11'S, 178°41'W, 400-401 m: 1 ♂ (MNHN-B 27651). — Stn CP 1481, 20°57'S, 178°45'W, 441-506 m: 1 juv. ♀ (MNHN-B 27652).

Source : MNHN, Paris

Palicoides whitei (Miers, 1884): SUVA 2, stn DW 62, Viti Levu, W lagoon, 17°49'S, 177°12.9'E, 32 m: 1 juv. ♀ (MNHN-B 27656).

Paliculus kyusyuensis (Yokoya, 1933): BORDAU 1, stn DW 1432, 17°20'S, 178°44'W, 477-493 m: 1 ♀ (MNHN-B 27653). — Stn CP 1507, 18°09'S, 178°38'W, 294-300 m: 1 ♀ (MNHN-B 27654).

Parapalicus ambonensis Moosa & Serène, 1981: BORDAU 1, stn DW 1494, 18°55'S, 178°29'W, 240-319 m: 1 ♂ (MNHN-B 27640). — Stn DW 1498, 18°41'S, 178°28'W, 300-307 m : 2 ♀ (MNHN-B 27641). — Stn CP 1507, 18°09'S, 178°38'W, 294-300 m: 1 ♂ ; 5 ♀ (MNHN-B 27642).

Parapalicus armatus Castro, 2000: BORDAU 1, stn CP 1475, 19°41'S, 178°11'W, 321-424 m: 1 ♀ (MNHN-B 27643).

Parapalicus clinodentatus Castro, 2000: BORDAU 1, stn CP 1445, 17°10'S, 178°42'W, 350-385 m: 6 ♂ (1 juv.); 3 ♀ (1 juv.) (MNHN-B 27644). — Stn CP 1446, 17°11'S, 178°42'W, 350-367 m: 2 juv. ♀ (MNHN-B 27645). — Stn CP 1500, 18°42'S, 178°26'W, 366-389 m: 2 ♂ ; 5 ♀ (MNHN-B 27646). — Stn CP 1501, 18°40'S, 178°30'W, 350-357 m : 5 ♂ ; 8 ♀ (2 juv.) (MNHN-B 27647).

Parapalicus inermis Castro, 2000: BORDAU 1, stn CP 1404, 16°40'S, 179°36'E, 180 m: 2 ♂ ; 4 ♀ (MNHN-B 27648). — Stn CP 1405, 16°39'S, 179°36'E, 180 m: 1 juv. ♀ (MNHN-B 27649).

Pseudopalicus declivis Castro, 2000: BORDAU 1, stn CP 1506, 18°09'S, 178°37'W, 294-300 m: 1 ♂ ; 1 juv. ♀ (MNHN-B 27638).

Pseudopalicus investigatoris (Alcock, 1900): BORDAU 1, stn DW 1473, 19°43'S, 178°10'W, 270-288 m: 1 juv. ♀ (MNHN-B 27639).

Pseudopalicus serripes (Alcock & Anderson, 1895): SUVA 2, stn CP 45, 17°51.6'S, 177°13.3'E, 35 m: 1 juv. ♀ (MNHN-B 27655).

Source : MNHN, Paris

Pycnogonida: Pycnogonids from French cruises to New Caledonia, Fiji, Tahiti and the Marquesas. New records and new species

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ABSTRACT

Pycnogonid material from the Muséum national d'Histoire naturelle, Paris, collected during French oceanographic campaigns to New Caledonia, Fiji, Tahiti and the Marquesas in 1993, 1996, 1997 and 1998, is described. Of the ten species recorded, *Anoplodactylus batangensis* (Helfer, 1938) and *A. pycnosoma* (Helfer, 1938) are newly recorded for New Caledonia; three of four recorded species of *Pallenopsis* are described as new (one of which was recorded previously from Vanuatu); a new species of *Austrodecus*, representing the fifth species of the subgenus *Tubidecus* is described from a single female. In the light of the intermediate morphology of an *Ammothella* specimen, and that of recent material from elsewhere, *A. indica* Stock is synonymized with *A. appendiculata* Dohrn.

RÉSUMÉ

Pycnogonida: Pycnogonides provenant de campagnes françaises en Nouvelle-Calédonie, aux îles Fidji, à Tahiti et aux îles Marquises. Nouvelles mentions et nouvelles espèces.

Des pycnogonides récoltés en Nouvelle-Calédonie, aux îles Fidji, à Tahiti et aux îles Marquises lors de diverses campagnes françaises en 1993, 1996, 1997 et 1998 sont étudiés. Parmi les 10 espèces identifiées, *Anoplodactylus batangensis* (Helfer, 1938) and *A. pycnosoma* (Helfer, 1938) sont mentionnés pour la première fois en Nouvelle-Calédonie; trois des quatre espèces de *Pallenopsis* récoltées sont décrites comme nouvelles (l'une d'entre elles ayant été déjà mentionnée en Vanuatu); une nouvelle espèce d'*Austrodecus*, représentant la cinquième espèce du sous-genre *Tubidecus* est décrite d'après une seule femelle. À la lumière de la morphologie intermédiaire présentée par un spécimen d'*Ammothella*, et de celle de matériel d'autre provenance, *A. indica* Stock est mise en synonymie avec *A. appendiculata* Dohrn.

BAMBER, R. N., 2000. — Pycnogonida: Pycnogonids from French cruises to New Caledonia, Fiji, Tahiti and the Marquesas. New records and new species. *In*: A. CROSNIER (ed.), Résultats des campagnes MUSORSTOM, Volume 21. *Mémoires du Muséum national d'Histoire naturelle*, **184**: 611-625. Paris ISBN-2-85653-526-7.

Source : MNHN, Paris

INTRODUCTION

Pycnogonid material from the Muséum national d'Histoire naturelle, Paris, collected during French oceanographic campaigns to New Caledonia, Fiji, Tahiti and the Marquesas in 1993, 1996, 1997 and 1998, has kindly been made available by Alain CROSNIER and Bertrand RICHER DE FORGES [IRD, Institut de Recherche pour le Développement (ex ORSTOM) et Muséum national d'Histoire naturelle, Paris] and is described herein.

There has been a number of French benthic marine research campaigns in the vicinity of New Caledonia since the late 1970s. Pycnogonid material from these surveys has been assessed and described by STOCK (1991; 1997), who recorded 67 species for the region, many from deeper waters (continental slope). Other recent studies of the New Caledonia pycnogonid fauna were those of CHILD (1977) and BAMBER (1997b), which dealt largely with shallower-water species.

There have been numerous recent publications on the pycnogonid fauna of other islands in the Indo-west and southern Pacific Oceans, notably by CHILD and, in shallow waters, MÜLLER, listed in, and including, STOCK (1994).

The present material comprises ten species; four are from shallow waters and include two species of *Anoplodactylus* new to New Caledonia; the six species from deeper water beam trawl samples include four species of *Pallenopsis*, three of which are described as new, together with a previously undescribed species of *Austrodecus* of the New Caledonia-endemic subgenus *Tubidecus*.

Material is deposited at the Muséum national d'Histoire naturelle, Paris (MNHN).

SYSTEMATIC ACCOUNT

The species recorded are:

Family Colossendeidae: *Colossendeis minor* Schimkewitsch, 1893;

Family Phoxichilidiidae: *Anoplodactylus batangensis* (Helfer, 1938); *A. pycnosoma* (Helfer, 1938);

Family Callipallenidae: *Pallenopsis (Bathypallenopsis) richeri* sp. nov.; *P. (Pallenopsis) sexacentra* sp. nov.; *Pallenopsis (P.) kupei* Clark, 1971; *P. (P.) mascula* sp. nov.;

Family Ammotheidae: *Achelia assimilis* (Haswell, 1885); *Ammothella appendiculata* (Dohrn, 1881);

Family Austrodecidae: *Austrodecus (Tubidecus) oferrecans* sp. nov.

Higher taxonomy follows that of ARNAUD and BAMBER (1987) except for the genus *Pallenopsis* which is now considered to be a member of the Callipallenidae.

Family COLOSSENDEIDAE Hoek, 1881

Genus ***COLOSSENDEIS*** Jarzynsky, 1870

Colossendeis minor Schimkewitsch, 1893

Colossendeis minor – STOCK, 1984: 702-704, figs 1-6.

MATERIAL EXAMINED. — **Society Islands**. ZEPOLYF 1: 19°15.5'S, 151°35.4'W, 618 m: 1 specimen (MNHN-Py 825).

Marquesas Islands. MUSORSTOM 9: stn CP 1262, Ua Pou, 09°20'S, 140°08'W, 850-905 m, 03.09.1997: 1 specimen (MNHN-Py 826).

REMARKS. — Recorded in this region by STOCK (1991), from 1300 to 2110 m; a widely distributed Indo-Pacific species known also from the North-east Atlantic, with a depth range of 1000 to 4850 m. The present records are therefore the shallowest for this species.

Source : MNHN, Paris

Family PHOXICHILIDIIDAE Sars, 1891

Genus ***ANOPLODACTYLUS*** Wilson, 1878

Anoplodactylus batangensis (Helfer, 1938)

Anoplodactylus batangensis – CHILD, 1992: 41-42, fig. 18.

MATERIA qui m'est imputable.ÉDITION MONTROUZIER: East Lagoon, Touho (Haut-Fond de Tie), 20°50'S, 165°20'E, 5-7 m, 19.09.1993: 1 male, 1 female (MNHN-Py 827).

REMARKS. — A pantropical-temperate species, known from the Caribbean, Australasia, W Africa, Pacific and Indian Oceans, from shallow water to 40 m. It has a distinctive upturned tapering or styliform proboscis without any processes in the female. Not recorded previously from New Caledonia.

Anoplodactylus pycnosoma (Helfer, 1938)

Anoplodactylus pycnosoma – MÜLLER, 1992: 173, figs 43-48.

MATERIAL EXAMINED. — **New Caledonia**. South West Lagoon, Récif Ricaudy, 22°20'S, 166°25'E, 10.04.1993: 1 female (MNHN-Py 828). — East Lagoon, Touho (Îlot de Sable), 20°50'S, 165°20'E, 5-7 m, 06.09.1993: 1 female (MNHN-Py 829).

REMARKS. — While isolated females of this genus are difficult to attribute to species, these specimens are entirely consistent with HELFER's Indo-West Pacific species, recorded from the shore down to over 100 m. Not recorded previously from New Caledonia.

Family CALLIPALLENIDAE Hilton, 1842

Genus ***PALLENOPSIS*** Wilson, 1881

Pallenopsis (Bathypallenopsis) richeri sp. nov.

Fig. 1

Pallenopsis (Bathypallenopsis) ?oculotuberculosis - STOCK, 1997: 406-407, fig. 7 (non *P. oculotuberculosis* Hilton, 1942).

MATERIAL EXAMINED. — **Fiji**. MUSORSTOM 10: stn CP 1361, 18°00.00'S, 178°53.71'E, 1058-1091 m, 13.08.1998: 1 female, holotype (MNHN-Py 830).

DESCRIPTION. — Trunk (Fig. 1A) elongate, fully segmented, lateral processes well-separated, naked; cephalon less than half trunk length, narrowing anterior to origin of first lateral processes where ovigers arise; ocular tubercle a medium dome, with eyes, of which anterior pair larger, and minute distolateral tubercles. Abdomen naked, exceeding 4th lateral process but not achieving distal edge of first coxa of 4th leg.

Proboscis cylindrical, widest at mid-point, 0.55 times total trunk length.

Chelifores (Figs 1B, C) with 2-articled scape, proximal article 1.34 times length of distal article; chela typical of genus, fingers without teeth, longer than palm, slender, tips crossing; no setose pad at base of moveable finger. Palps small, one-articled, ventrolateral knobs.

Oviger (Fig. 1E) 10-articled, articles 4 and 5 subequal and dorsally spinose; articles 6 to 9 with simple spines as figures; article 10 (Fig. 1F) with 3 inner spines and larger curved terminal spine with appearance of a terminal claw.

Source : MNHN, Paris

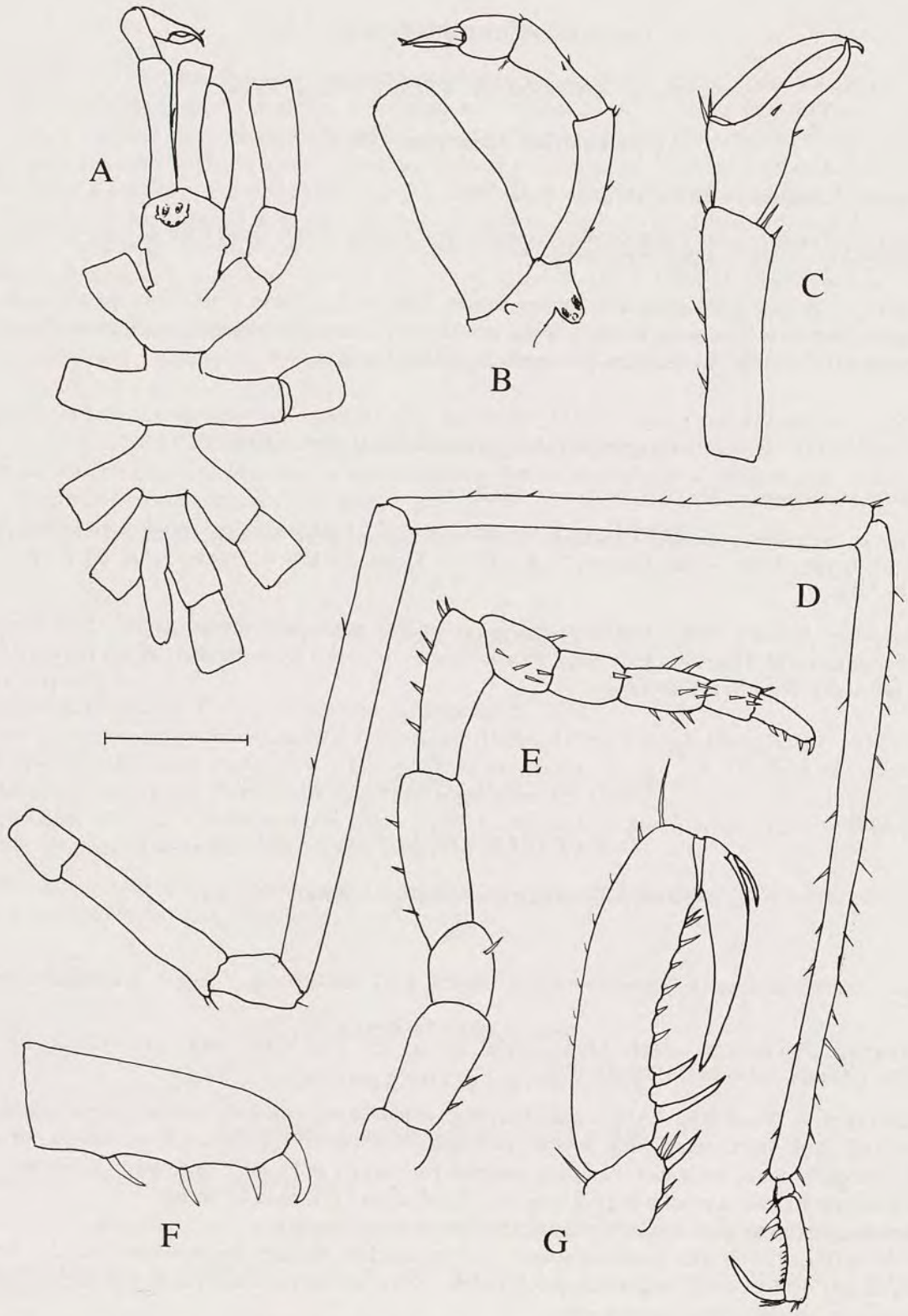

FIG. 1. — *Pallenopsis (Bathypallenopsis) richeri* sp. nov., holotype female: **A**, trunk, dorsal; **B**, cephalon, proboscis and chelifore; **C**, chela; **D**, 3rd leg; **E**, oviger; **F**, distal oviger article; **G**, propodus and claws, 4th leg. Scale line = 2 mm for A, B and D, 1 mm for C and E, 0.2 mm for F and 0,7 mm for G.

Source : MNHN, Paris

Third leg (Fig. 1D): coxa 1 short; coxa 2: 3 times length of coxa 1; coxa 3: 0.4 coxa 2; femur straight, simple, with dorsodistal spine group, tibia 1 subequal to femur, tibia 2 longest article, tibiae with spines and setae not as long as diameter of tibia and not denticulate, dorsally on tibia 1 and dorsally and ventrally on tibia 2; tarsus small; propodus (Fig. 1G) with 2 unequal heel spines and 6 to 8 sole spines, the distal pair laterally adjacent; main claw 0.63 times propodus length and 4 times length of auxiliary claws.

Male unknown.

Measurements of holotype female (mm). — Trunk length: 5.85; proboscis length (ventral): 3.19; chelifore scape article 1: 2.19, article 2: 1.63.

Third leg: coxa 1: 0.8; coxa 2: 2.88; coxa 3: 1.08; femur: 7.2; tibia 1: 7.6; tibia 2: 10; tarsus: 0.2; propodus: 1.54; main claw: 0.97.

ETYMOLOGY. — Named after Bertrand RICHER DE FORGES of IRD, who collected most of the material available for study.

REMARKS. — STOCK (1997) recorded and described a specimen (MNHN-Py 932), also a female, from Vanuatu (15°53.81'S, 162°52.19'E) at 1100-1191 m depth, which he attributed tentatively to HILTON's *P. oculotuberculosis*, a species recently redescribed by CHILD (1994). The latter species is characterized by prominent lateral tubercles on the tall ocular tubercle and article 1 of the chelifore scape exceeding the proboscis. The present species has a lower ("normal") ocular tubercle and the proximal scape article is far shorter than the proboscis (0.7 times dorsal proboscis length). While the lateral tubercles on the ocular tubercle are more prominent in STOCK's specimen than in the present specimen, they do not suggest the bifurcation that those of HILTON's species do, and I conclude that the Vanuatu and Fiji specimens are conspecific and distinct from *P. oculotuberculosis*.

There are few *Pallenopsis* species with only two major heel spines, although current studies of *P. tritonis* Hoek, 1883 show this feature to be variable, partly with maturity (unpubl. data). The conformation of the proboscis places *P. richeri* sp. nov. within STOCK's (1975) "*tydemani*-group"; it is distinct from *P. tydemani* Loman, 1908 owing to its well-developed ocular tubercle with eyes, propodal spination, proportion of scape articles and oviger spination, and from *P. tritonis* by the proboscis length to trunk length proportions, proportion of scape articles and the lack of denticulate spines on the longer leg articles. Analysis of the leg article proportions suggests closest affinity to *P. californica* Schimkewitsch, 1893 (see STOCK, 1975, for redescription), but that species has a much longer main claw, dense long setae on the longer leg articles, and distinct oviger spination.

P. richeri sp. nov. is known from the Melanesian islands of Fiji and Vanuatu, at depths between 1058 and 1191 m.

Pallenopsis (Pallenopsis) sexacentra sp. nov.

Figs 2-4

MATERIAL EXAMINED. — **Fiji**. MUSORSTOM 10: stn CP 1358, 17°48.49'S, 178°46.70'E, 80-120 m, 13.08.1998: 1 male carrying eggs, holotype (MNHN-Py 831); 1 male and 3 females, paratypes (MNHN-Py 832).

DESCRIPTION OF MALE. — Trunk (Figs 2A-B) elongate, fully segmented, with paired mid-dorsal spines at posterior margin of trunk segments 1 to 3; lateral processes separated by just less than their own width, first 3 with paired dorsodistal spines, fourth with 3 or 4 such spines. Cephalon half length of trunk, narrowing anteriorly; ocular tubercle dome-like, eyes pigmented, anterior pair larger than posterior pair. Abdomen about as long as 4th lateral process, armed with paired dorsodistal spines.

Proboscis stout, shorter than cephalon, with sparse short spines on distal half.

Chelifore scape 1-articled, exceeding proboscis. Chela (Fig. 2C) setose, moveable finger with setose basal pad, fixed finger with crenulated cutting edge. Palps small, one-articled, ventrolateral knobs.

Oviger (Figs 3B-C) 10-articled; article 1 short; article 2: 3 times as long as wide; article 3: 0.54 times article 2; article 4 twice article 3, with mid-ventral indentation; article 5: 1.2 times article 4, with rows of stout setae; distal articles (Fig. 3C) each with numerous stout setae, pointing predominantly proximally. No terminal claw.

Source : MNHN, Paris

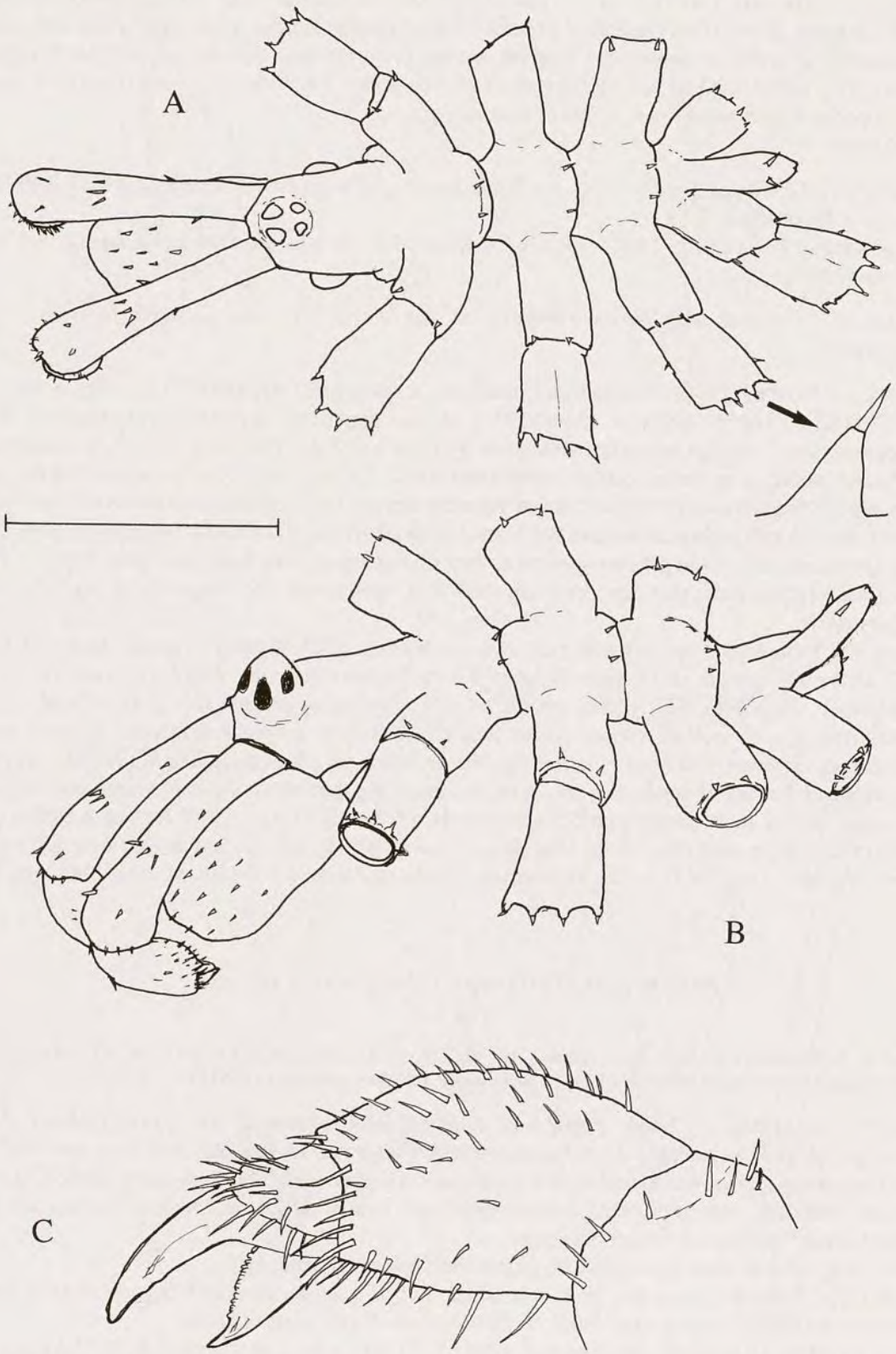

FIG. 2. — *Pallenopsis (Pallenopsis) sexacentra* sp. nov.: **A**, holotype male, trunk, dorsal; **B**, paratype male, trunk, dorsolateral; **C**, right chela. Scale line = 2 mm for A and B, 0.4 mm for C.

Source : MNHN, Paris

Third leg (Fig. 4A) elongate; coxa 1 (also Figs 2A, B) with 4 dorsodistal tubercles each bearing short distal seta; coxa 2 nearly 4 times coxa 1 length, with conspicuous dorsal genital pore in distal third and ventrodistal setose tubercle ("spur"); coxa 3 longer than coxa 1. Femur sparsely setose, without distal spur, slender mid-ventral cement-gland tube just longer than femoral diameter; tibia 1 as long as femur but more slender, tibia 2 longest. Tarsus (Fig. 4B) short, ventrodistal spines stout; propodus elongate, slightly curved, 3 heel spines progressively larger distally, 12 to 14 small sole spines, elongate setae distally and dorsally; main claw 0.53 times length of propodus, auxiliary claws 0.8 of main claw.

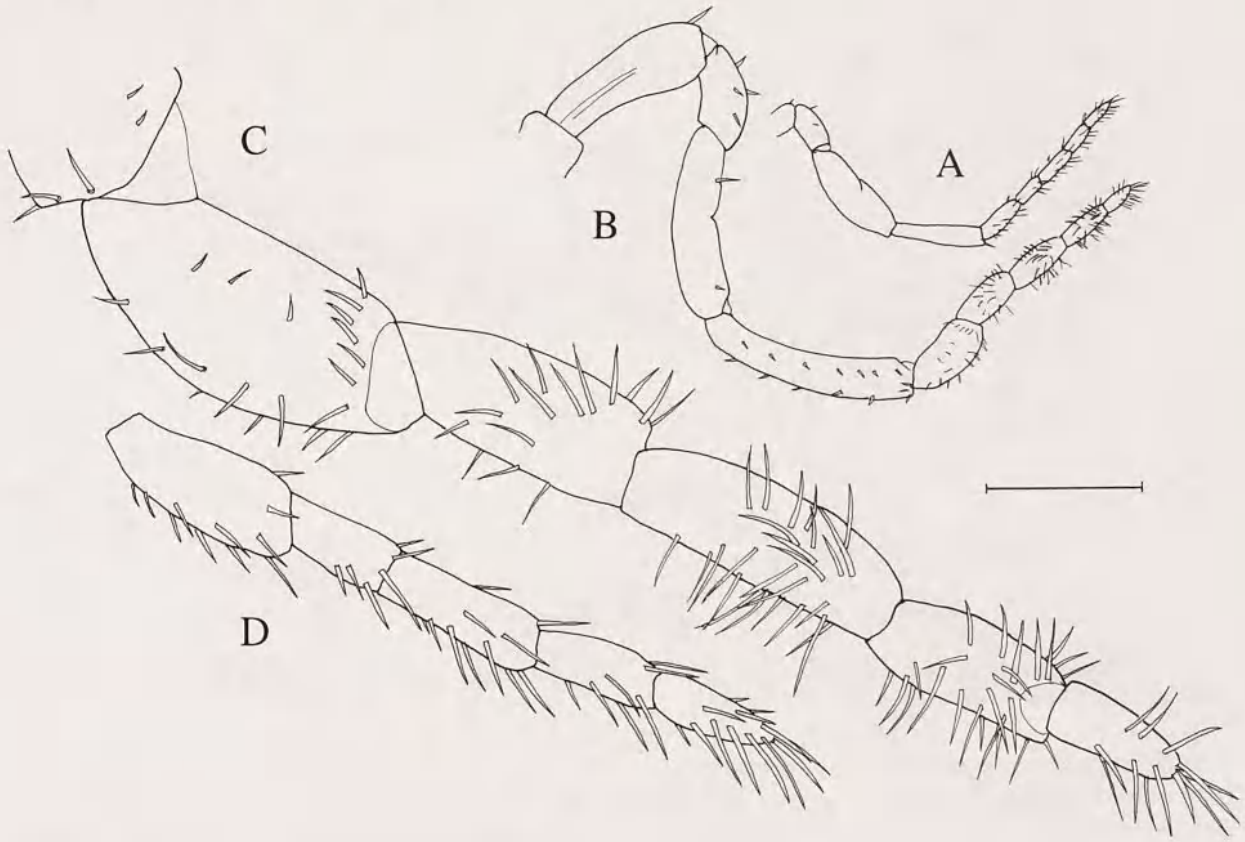

FIG. 3. — *Pallenopsis (Pallenopsis) sexacentra* sp. nov., paratypes; oviger of **A**, female and **B**, male (distal setation semidiagrammatic); distal oviger articles of **C**, male and **D**, female. Scale line = 1 mm for A and B, 0.23 mm for C and D.

DESCRIPTION OF FEMALE. — Generally similar to male, but femur slightly stouter and without cement gland. Oviger (Fig. 3A) much smaller (Figures 3A and B are to the same scale from similarly-sized, mature animals), of 10 articles, distal five articles (Fig. 3D) with numerous, predominantly ventral, stout setae, all pointing distally.

Measurements of holotype male (mm). — Trunk length: 3.8; proboscis length (ventral): 1.48; chelifore scape: 1.84.

Third leg: coxa 1: 0.51; coxa 2: 1.79; coxa 3: 0.76; femur: 4.15; tibia 1: 4.29; tibia 2: 4.68; tarsus: 0.11; propodus: 0.87; main claw: 0.48; auxiliary claw: 0.33.

ETYMOLOGY. — from the Latin "six prickled", referring to the mid-dorsal trunk spines.

REMARKS. — A number of shallower-water (30 to 300 m) species of this subgenus have been recorded from this region (e.g. STOCK 1983; 1991; 1997) of a similar overall morphology, including *Pallenopsis spinipes* Carpenter 1907, *P. dentifera* Stock, 1983 and *P. virgata* Loman, 1908. *P. spinipes* is distinct in its touching first

Source : MNHN, Paris

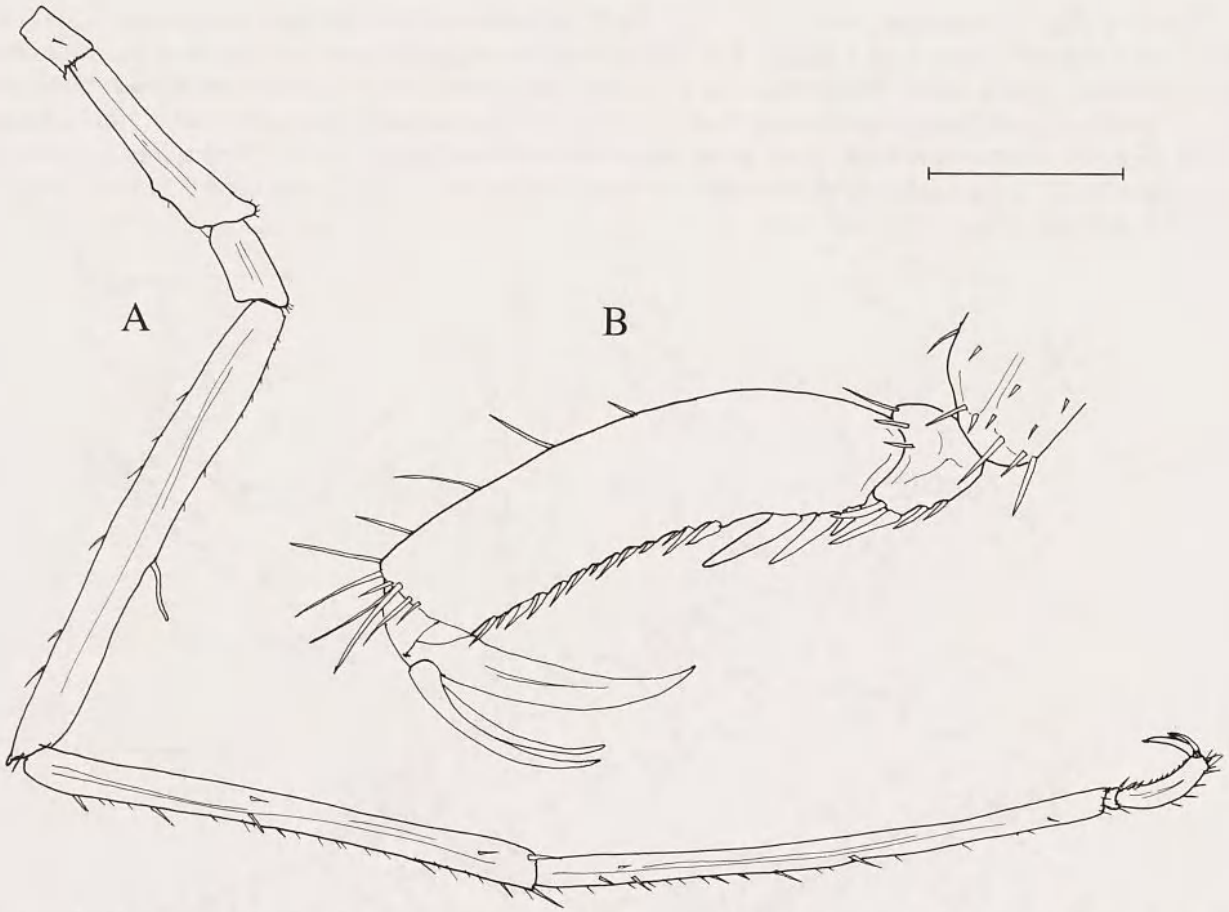

FIG. 4. — *Pallenopsis (Pallenopsis) sexacentra* sp. nov., male holotype, third leg, **A**, entire and **B**, detail of distal articles. Scale line = 2 mm for A, 0.4 mm for B.

pair of lateral processes, and in having barbed spines on the legs. *P. dentifera* has a similar crenulation of the cutting edge of the chela fixed finger as does *P. sexacentra* sp. nov., but is without spines on the trunk segments or lateral processes. *P. virgata* has setose/spinose tubercles distally and laterally on the femur and tibia 1. There are subtle differences in the propodal spination of these species. None, however, has the paired mid-dorsal trunk spines shown by *P. sexacentra* sp. nov. nor the degree of development of dorsodistal setose tubercles on coxa 1.

Pallenopsis (Pallenopsis) kupei Clark, 1971

Pallenopsis kupei - CLARK, 1971: 430-433, fig. 2. — CHILD, 1995: 143.

MATERIAL EXAMINED. — **Fiji**. MUSORSTOM 10: stn CP 1344, 16°45.26'S, 177°40.53'E, 588-610 m, 10.08.1998: 1 female (MNHN-Py 834).

REMARKS. — A species previously recorded from the Antarctic north to northern New Zealand, at depths between 121 and 1097 m.

Pallenopsis (Pallenopsis) mascula sp. nov.

Figs 5-6

MATERIAL EXAMINED. — **Fiji**. MUSORSTOM 10: stn CP 1364, 18°11.95'S, 178°34.50'E, 80-86 m, 15.08.1998: 1 male, holotype (MNHN-Py 835).

Source : MNHN, Paris

DESCRIPTION. — Trunk (Figs 5A-B) elongate, slender, fully segmented, moult suture apparent laterally on all segments, cuticle finely reticulated; cephalon tapering anteriorly, ocular tubercle tall, with eyes, mounted at anterior of cephalon; lateral processes long, separated by about their own width, with anterior and posterior lateral setae and three slender dorsodistal tubercles bearing setae, central one longest, about as long as lateral process diameter. Abdomen with basal articulation, exceeding first coxae of fourth legs and as long as first 2 trunk segments, with 3 pairs of dorsal setose tubercles.

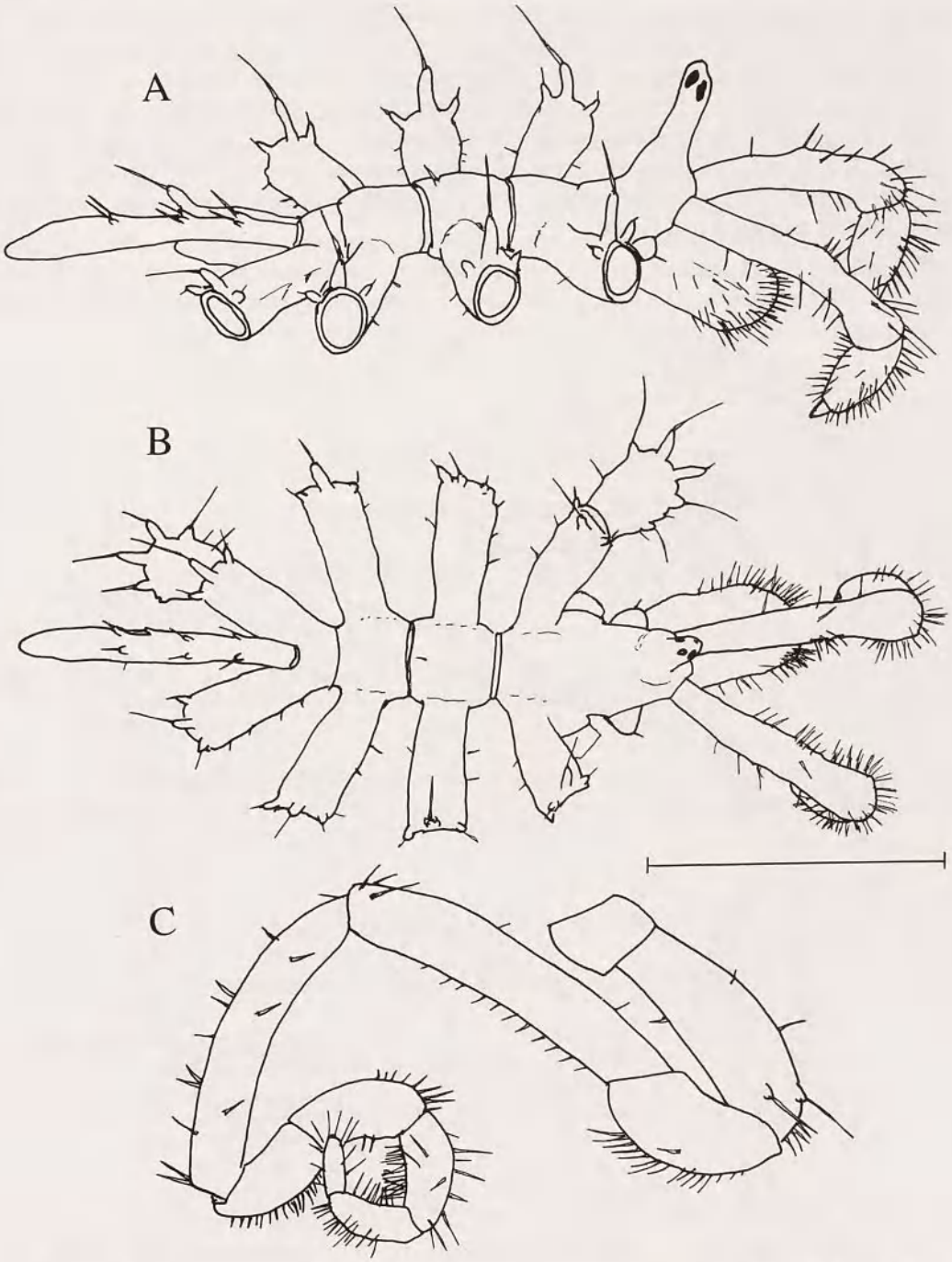

FIG. 5. — *Pallenopsis (Pallenopsis) mascula* sp. nov., holotype male: habitus, **A** lateral and **B** dorsal; **C**, oviger. Scale line = 2 mm for A and B, 0.95 mm for C.

Source : MNHN, Paris

Proboscis short, cylindrical, densely setose.

Chelifore scape without articulation, setose distally, without tubercles; chela (Fig. 6A) with rectangular, densely setose palm, fingers anaxial, denticulate, setose cushion at base of moveable finger.

Palp conspicuous, semicircular, with basal articulation and distal seta.

Oviger (Fig. 5C) 10-articled, all but first article setose, article 2 slightly inflated with 2 distal setose tubercles, article 3 short, slightly inflated, article 4 elongate, straight, article 5 as long as article 4 with proximally directed setae; distal five articles heavily setose, article 10 more than twice as long as wide.

Leg (Figs 6B-C) moderately elongate, setose with most setae longer than article diameters; coxa 1 with lateral setae and 4 or 5 dorsodistal setose tubercles; coxa 2 setose, without tubercles, 3 times length of coxa 1; coxa 3 half length of coxa 2; femur with few dorsal and single dorsodistal setose tubercles, with midventral cement-gland tube twice as long as femur diameter and mounted on large eminence; tibiae densely setose with rows of dorsal setose tubercles, tibia 1 longer than tibia 2; tarsus short with 4 short "sole setae", 2 ventral and 1 dorsal distal spines; propodus with 2 heel spines lying close to propodal ventral margin, about 12 sole spines, 3 dorsal setae and 5 distal setae above main claw; main claw slender, curved, two-thirds length of propodus, auxiliary claws long, slender, curved, almost as long as main claw.

Female unknown.

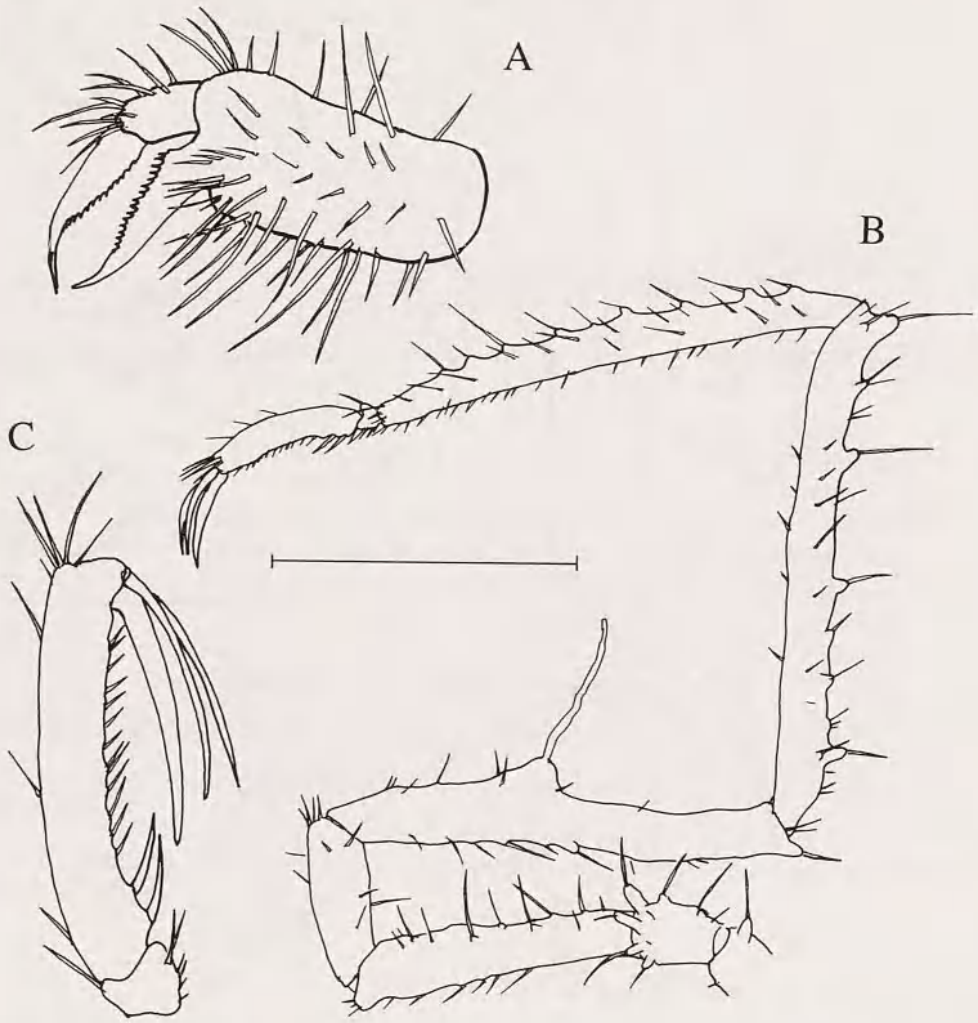

FIG. 6. — *Pallenopsis (Pallenopsis) mascula* sp. nov., holotype male: **A**, chela; **B**, 4th leg; **C**, distal articles of 3rd leg. Scale line = 0.75 mm for A and C, 2 mm for B.

Source : MNHN, Paris

Measurements of holotype male (mm). — Trunk length: 3.42; trunk width across 2nd lateral processes: 2.35; proboscis length: 1.15; ocular tubercle height: 0.84; abdomen length: 1.93.

Fourth leg: coxa 1: 0.57; coxa 2: 1.81; coxa 3: 0.91; femur: 2.91; tibia 1: 3.51; tibia 2: 3.2; tarsus: 0.11; propodus: 0.97; main claw: 0.66; auxiliary claws: 0.57.

ETYMOLOGY. — From the Latin for "male", alluding both to the extremely well-developed cement-gland mound and tube, and the dense "beard" of setae on the proboscis.

REMARKS. — Of a number of species of *Pallenopsis* with long setae mounted on tubercles on the longer leg articles, the new species is closest to *P. cidaribatus* Child, 1975, recorded from Western Australia at depths between 100 and 141 m. Both are distinct from the other species in having three slender setose tubercles, each bearing a long distal seta, around the dorsodistal margin of the lateral processes, together with a "crown" of such tubercles distally on the first coxa. Those of *P. cidaribatus* are much longer; but with only three tubercles on coxa 1 compared with four or five in *P. mascula*. Further, the leg tubercles of *P. cidaribatus* are longer than those of the Fiji species; conversely, the cement gland tube of *P. mascula* is mounted on a femoral eminance and unusually long, at 1 mm more than twice the diameter of the femur (about as long as femoral diameter in *P. cidaribatus*). *P. cidaribatus* has unusual paired tubercles lateral to the ocular tubercle (absent in *P. mascula*), a distal oviger article no longer than wide (much longer than wide in *P. mascula*), chela fingers without denticulation (heavily denticulate in *P. mascula*) and proportionately shorter claws on the propodus.

Family AMMOTHEIDAE Dohrn, 1881

Genus ***ACHELIA*** Hodge, 1864

Achelia assimilis (Haswell, 1885)

Achelia assimilis - STOCK, 1994: 32-33, fig. 9.

MATERIAL EXAMINED. — **New Caledonia**. Lagoon: Récif Mbere, external slope, 22°19.9'S, 166°13.2'E, 10-15 m, 07.01.1993: 1 male (MNHN-Py 837). — East Lagoon: Touho (Haut-Fond de Tie), 20°50'S, 165°20'E, 5-7 m, 19.09.1993: 1 male (MNHN-Py 838).

REMARKS. — A species which ranges from 0 to 900 m depth, widely recorded from the Indo-West Pacific, Australia, New Zealand, the Subantarctic and coasts of Chile and Argentina; previously recorded from New Caledonia by CHILD (1977) and STOCK (1997).

Genus ***AMMOTHELLA*** Verrill, 1900

Ammothella appendiculata (Dohrn, 1881)

Ammothea appendiculata Dohrn, 1881: 152-155, pl. 7.
Ammothella indica Stock, 1954: 113-119, figs 54-57 (new synonymy).

MATERIAL EXAMINED. — **New Caledonia**. Grotte Merlet, outer slope of barrier reef, 22°43.50'S, 166°41.00'E, 20-30 m, 19-21.01.93: 1 female (MNHN-Py 839).

REMARKS. — The problems of distinguishing *A. indica* Stock from *A. appendiculata* (Dohrn) were highlighted by STOCK himself in his original description of the former (loc. cit.); characters such as the density of blunt "tubular" spines on the leg articles, and the relative proportions of the chelifore scape articles, are somewhat subjective, while the presence or absence of blunt spines on the proximal scape article shows no congruence with

Source : MNHN, Paris

the typical expression of these other features (see, for example, BAMBER, 1997a). It is also the case that the expression of these features varies with maturity.

The present fully mature female, from typical *A. indica* geographic range, has slender leg articles (containing eggs), sparsely furnished with blunt spines (an *A. appendiculata* character), scape article 2 flared, distally fully enclosing the vestigial chela, and about twice the length of article 1 (an *A. appendiculata* character); the latter bears a single blunt spine (characteristic of *A. indica*); lateral processes are not markedly elongate (width across 2nd lateral processes 2.3 times 2nd trunk segment width, compared with three times in *A. indica*).

With the frequency of specimens showing intermediate morphology, and the inconsistency of occurrence of the characterizing features, I see no reason to maintain further the distinction of these two species. STOCK (1997) recorded 1 male, as *A. indica*, from Récif Senez at 7 m.

Family AUSTRODECIDAE Stock, 1954

Genus *AUSTRODECUS* Hodgson, 1907

Austrodecus (Tubidecus) oferrecans sp. nov.

Fig. 7

MATERIAL EXAMINED. — **New Caledonia**. HALIPRO 2, stn BT 60, 24°52'S, 168°44'E, 1133-1280 m, 18.11.1996: 1 female, holotype (MNHN-Py 841).

DESCRIPTION. — Trunk (Figs 7A-B) typical of the subgenus, completely segmented, with the segment length anterior to the lateral processes increasing from the cephalon to trunk segment 4 (thus 2nd and 3rd lateral processes separated by about their own width); lateral processes less than twice as long as trunk diameter, and bearing tuberculation on dorsal and lateral surfaces. Cephalon with tall, slender anterior ocular tubercle with distal tuberculation and eyes; slender mid-dorsal post-ocular tubercle either short or (presumed) broken. Remaining trunk segments with tall, slender (filiform) mid-dorsal trunk tubercles, each bearing subdistal seta. Abdomen reaching distal edge of coxa 1 of 4th leg.

Proboscis (Fig. 7B) slender and tapering, nearly twice as long as trunk length, distally down-curved, annulated.

Palp (Figs 7A-B and D) of 6 articles, articles 2 to 4 bearing dense thorn-like tuberculation; article 2 longest, as long as trunk; article 4 length 60% that of article 2, bearing 6 inner slightly-curved spines; articles 5 and 6 anaxially articulated, short, with distal setae.

Chelifores absent.

Oviger (Fig. 7C) small, of 4 articles, articles 2 and 3 with single distal setae, article 4 twice length of article 2 with single medial and 3 distal setae (spinules).

Legs (Fig. 7E) with stout, tuberculate coxae; coxa 1 armed distodorsally with 1 short and 1 long filiform, irregular tubercle, the latter with subdistal seta; coxa 2 nearly twice length of coxa 1; coxa 3 shortest, with irregular filiform dorsal tubercle. Femur slender, tuberculate, longer than either tibia; tibiae elongate, slender, not tuberculate, tibia 1 longer than tibia 2 and with dorsodistal spine, tibia 2 with spine on swollen base distal of mid-dorsal; distal leg articles (Fig. 7F), tarsus short, rectangular, with 3 ventral spines; propodus slender, elongate, with numerous sole setae, decreasing in number from anterior to posterior legs (23 on 2nd, 12 on 3rd), 3 or 4 dorsal spines and 3 distal spines; main claw short, blunt, one-quarter the length of the propodus; auxiliary claws absent.

Male unknown.

Measurements of female (mm). — Trunk length: 1.34; width across 2nd lateral processes: 1.0; ocular tubercle length: 0.855; abdomen length: 0.23.

Third leg: coxa 1: 0.23; coxa 2: 0.4; coxa 3: 0.14; femur: 1.25; tibia 1: 1.17; tibia 2: 0.80; tarsus: 0.04; propodus: 0.46; claw: 0.113.

Source : MNHN, Paris

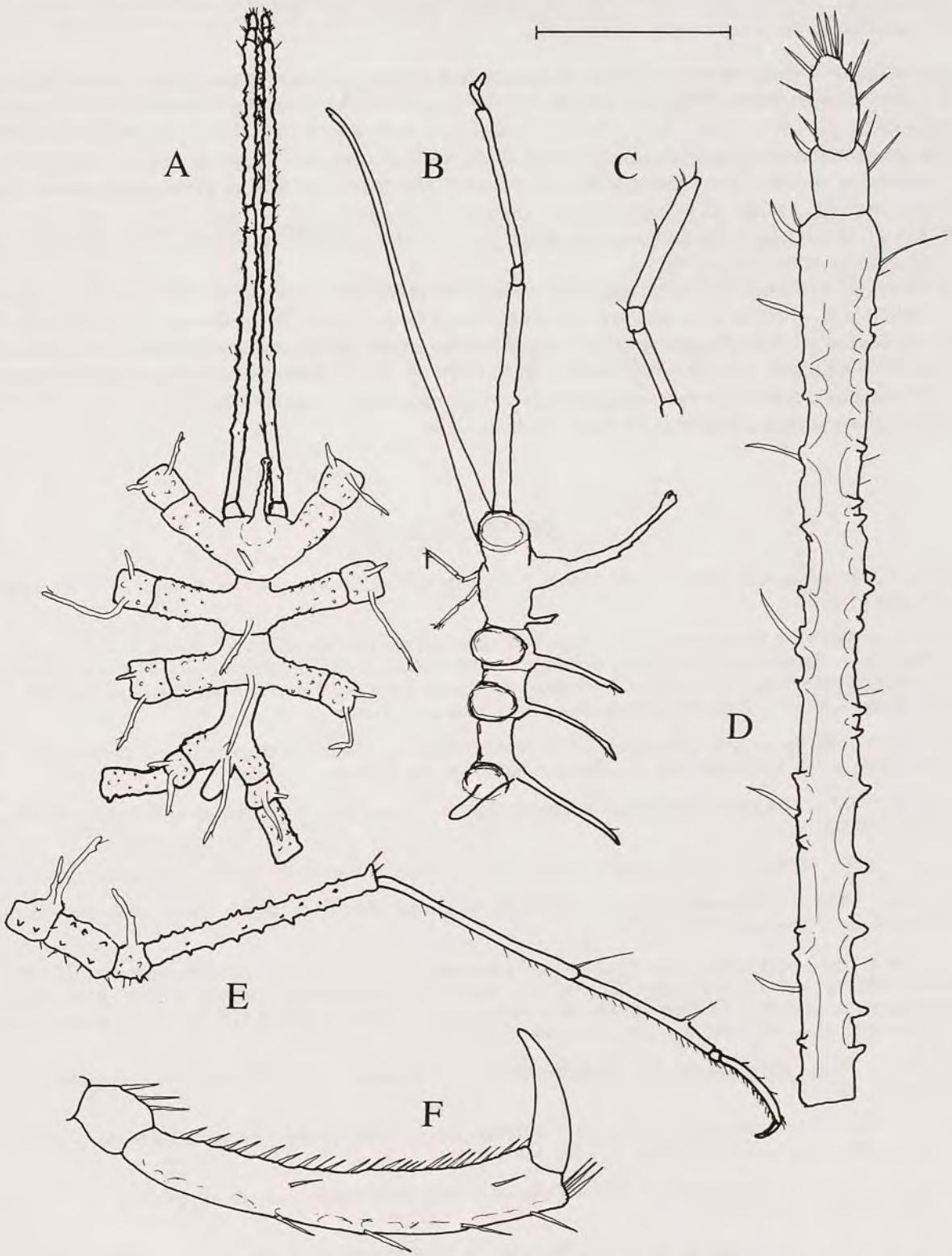

FIG. 7. — *Austrodecus (Tubidecus) oferrecans* sp. nov., holotype female: **A**, habitus, dorsal and, **B**, lateral; **C**, oviger; **D**, distal articles of palp, dorsal; **E**, 3rd leg; **F**, distal articles of 2nd leg. Scale line = 1 mm for A, B and E; 0.17 mm for D and F; 0.3 mm for C.

Source : MNHN, Paris

ETYMOLOGY. — From the Anglo-Saxon *ofer* meaning "beyond" and *raecan* to reach or extend (thus "over-reach"), alluding to the elongate palps of this species.

REMARKS. — The only described *Tubidecus* species with a postocular dorsal trunk tubercle on the cephalon is *A. (T.) tuberculatum* Stock, 1991, but that species has a distinctly longer abdomen, more than 2 distodorsal tubercles on the 1st coxa of legs 1 to 3, a less tuberculate palp and markedly less slender leg articles. The present species resembles more closely *A. (T.) bathyale* Stock, 1991 (known only from the male), from which it is distinguished by the postocular cephalon tubercle, the main claw and tarsus being proportionately shorter, coxa 2 being less elongate, and the very long palps [1.8 times the trunk length in *A. (T.) oferrecans* sp. nov., only 1.42 times in *A. (T.) bathyale*]. While the coxal proportion may be a gender-related morphology, these other features are not attributable to sexual dimorphism.

In a number of respects the present species is intermediate between these two of STOCK's species; however, as only 7 individuals of these three taxa are at present known (indeed, only 20 specimens of the five described *Tubidecus* species), it is not feasible as yet to suggest that the present species and *A. (T.) bathyale* (recorded from 1665-1590 m) represent attenuate deeper-water phenotypes of *A. (T.) tuberculatum*. The present specimen is presently considered distinct, characterized particularly by the exceedingly elongate palps.

The subgenus remains confined to the New Caledonia region.

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Source : MNHN, Paris

Source : MNHN, Paris

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Echinodermata Crinoidea: Comatulid Crinoids of the KARUBAR Expedition to Indonesia. The families Comasteridae, Asterometridae, Calometridae and Thalassometridae

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ABSTRACT

Fifteen species of comatulid crinoids in eleven genera and four families collected in 180-800 m by the joint French-Indonesian KARUBAR Expedition to the Kai and Tanimbar Islands, Indonesia (October 1991), are described in detail. The specimens represent the most important collection of bathyal comatulids from the East Indies in the second half of the twentieth century. The material described herein comprises four species of Comasteridae, one Asterometridae, two Calometridae and eight Thalassometridae. One species of calometrid (*Neometra xenocladia* sp. nov.) is described as new. Five species are recorded for the first time since they were originally collected. Four thalassometrids (*Aglaometra valida*, *Oceanometra annandalei*, *Cosmiometra philippinensis* and *Stenometra cristata*) together account for 75% of identified specimens, reflecting this family's importance to the outer shelf-upper bathyal comatulid fauna of the tropical Indo-Western Pacific. The substantial amount of material of several species, notably *A. valida* and *O. annandalei*, permits a better understanding of morphological variability than previously. Statistical analyses of several supposedly diagnostic characteristics, including aspects of calyx form and number of cirri, reveal substantial variation. We place several taxa in synonymy as a result. SEM studies of different ossicles have been made for the first time for *A. valida* and *O. annandalei*. The preliminary results show that great morphological differences exist within the family.

Three species (*Stiremetra breviradia*, *Palaeocomatella hiwia* and *Cosmomietra iole*) are recorded from Indonesian waters for the first time. Moreover, most of the KARUBAR comatulids represent geographical and bathymetrical range extensions.

MESSING, C. G., AMÉZIANE, N. & ELEAUME, M., 2000. — Echinodermata Crinoidea: Comatulid Crinoids of the KARUBAR Expedition to Indonesia. The families Comasteridae, Asterometridae, Calometridae and Thalassometridae. *In*: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 21. *Mémoires du Muséum national d'Histoire naturelle*, **184**: 627-702. Paris ISBN-2-85653-526-7.

Source : MNHN, Paris

RÉSUMÉ

Echinodermata Crinoidea : Comatules récoltées lors de la campagne KARUBAR en Indonésie. Familles Comasteridae, Asterometridae, Calometridae et Thalassometridae.

Quinze espèces de comatules, appartenant à 11 genres et quatre familles, récoltées en octobre 1991, entre 180 et 800 m, lors de la campagne franco-indonésienne KARUBAR aux îles Kai et Tanimbar (Indonésie) sont décrites en détail. Les échantillons récoltés forment la collection de comatules bathyales la plus importante faite dans la région durant la seconde moitié du XXème siècle. Le matériel étudié ici comprend quatre espèces de Cosmateridae, une d'Asterometridae, deux de Calomatridae et huit de Thalassometridae. Une espèce, *Neometra xenocladia*, est nouvelle. Cinq sont signalées pour la première fois depuis leur description. Quatre espèces appartenant à la famille Thalassometridae, *Aglaometra valida*, *Oceanometra annandalei*, *Cosmiometra philippinensis* et *Stenometra cristata*, représentent 75% des spécimens récoltés, montrant l'importance de cette famille dans la faune des comatules de la zone bathyale supérieure de la pente continentale dans l'Indo-ouest Pacifique. Les récoltes abondantes de plusieurs espèces, notamment *Aglaometra valida* et *Oceanometra annandalei*, ont permis de mieux appréhender la variabilité de certains caractères morphologiques. Des analyses statistiques de plusieurs caractères supposés diagnostiques, notamment la forme des calices et le nombre de cirres, ont montré des variations substantielles. Ceci nous a conduit à établir plusieurs synonymies. Des études au SEM des différents ossicules ont été faites pour la première fois sur *A. valida* et *O. annadelei*. Les résultats préliminaires montrent de grandes différences morphologiques à l'intérieur d'une même famille.

Trois espèces, *Stiremetra breviradia*, *Palaeocomatella hiwia* et *Cosmomietra iole* sont signalées dans les eaux indonésiennes pour la première fois. De plus, la plupart des espèces mentionnées voient leurs répartitions géographique et bathymétrique étendues.

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Source : MNHN, Paris

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INTRODUCTION

Comatulid crinoids form an ecologically important component of benthic communities in many areas of Recent seas. Because many species, particularly those from deeper water, are known from only a few specimens, their morphological variability, taxonomic relationships, behavior and habits remain poorly understood.

The comatulids dredged by the joint French-Indonesian KARUBAR Expedition to the Kai and Tanimbar Islands (Kepulauan Kai and Kepulauan Tanimbar), Indonesia (October 1991), represent the only major collection of these animals taken from bathyal East Indian waters during the second half of the twentieth century. Previous important collections include those made by MORTENSEN (Danish, 1914-1916, 1922), and the *"Challenger"* (British, 1872-1876), *"Siboga"* (Dutch, 1899-1900), *"Albatross"* (U.S. Fish Commission, 1907-1910), and *"Willebrord Snellius"* (Swedish, 1929-1930) expeditions (see A.H. CLARK, 1918, 1931, 1941, 1947, 1950; A.H. CLARK and A.M. CLARK, 1967).

The following systematic account covers all collected material except that belonging to the families Charitometridae (superfamily Tropiometracea) and Antedonidae (superfamily Antedonacea). The former in particular requires a major revision before the KARUBAR collection can be meaningfully identified. Identified material includes taxa belonging to the superfamilies Comasteracea and Tropiometracea as follows: Comasteridae (4 species in 3 genera), Asterometridae (1 species), Calometridae (2 species in 1 genus), and Thalassometridae (8 species in 6 genera). Specimens were collected between about 180 and 800 m, with most stations in 200-400 m and a single station recorded as 124-850 m. We review geographic and bathymetric distributions of all species represented.

The substantial amount of material of several species, notably the thalassometrids *Oceanometra annandalei* (A.H. Clark) (40 specimens) and *Aglaometra valida* (Carpenter) (31), permits a better understanding of morphological variability than previously. In particular, statistical analyses on these two species indicate that several morphological features formerly considered as diagnostic (e.g., centrodorsal shape, number of cirri) are extremely variable. We place several taxa in synonymy as a result. Skeletal ossicles of these two species plus a third, *Stenometra cristata* (A.H. Clark) (25 specimens), have been examined using scanning electron microscopy

Source : MNHN, Paris

(SEM) for the first time. Future comparisons of this material with other members of the family may provide additional diagnostic features. Perhaps more than anything else, this collection indicates how severely most comatulid families stand in need of detailed morphological examination, character analysis, and phylogenetic hypothesis-testing.

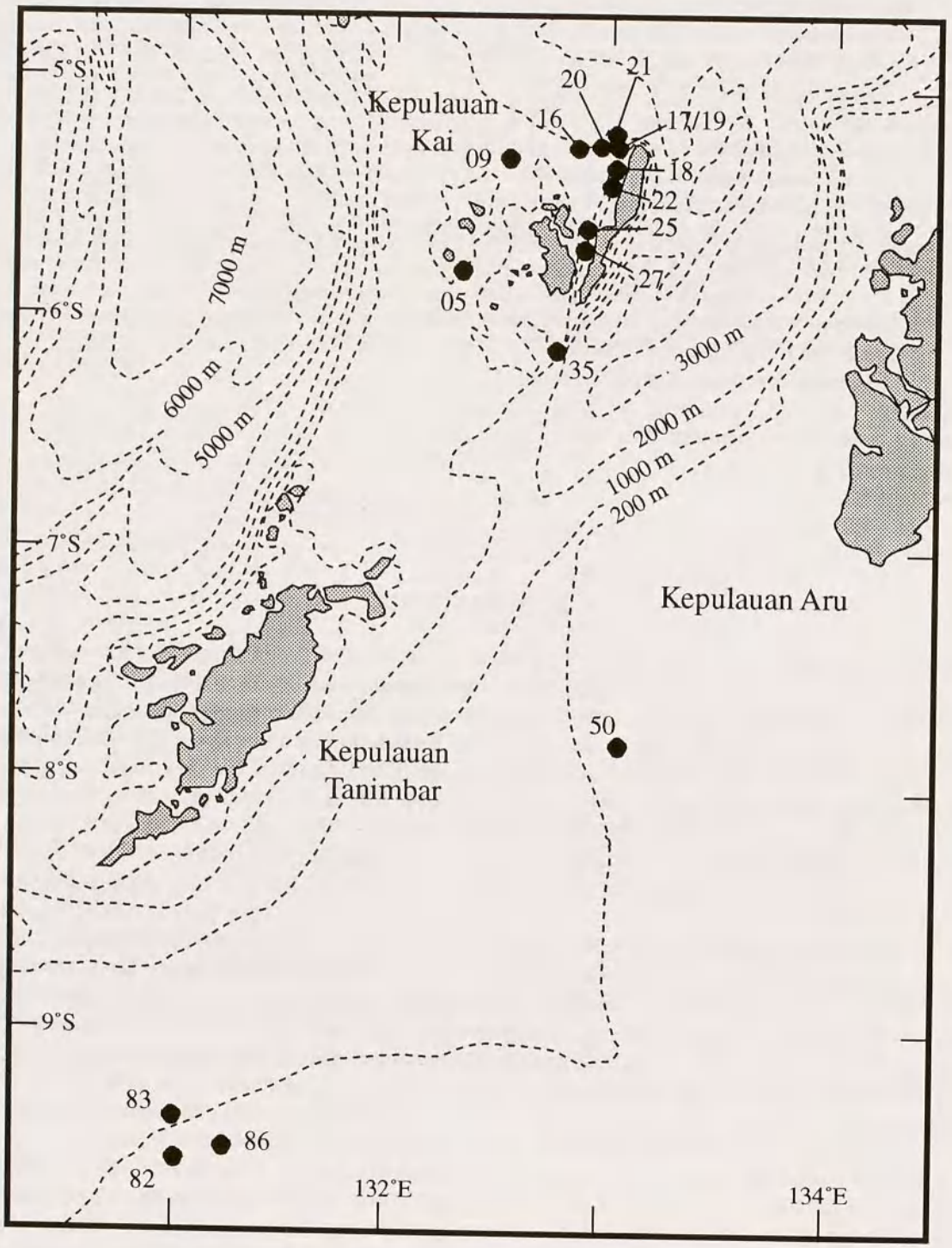

FIG. 1. — Map of KARUBAR Expedition stations at which comatulid crinoids were dredged.

Source : MNHN, Paris

CHECKLIST OF COMATULIDS

STATION LIST

The following list of stations includes latitude, longitude, depth, date, gear and number of specimens of each species collected. Figure 1 illustrates station locations. Table 1 summarizes species collected at each station.

Species	Station																
	5	*9*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*25*	*27*	*32*	*35*	*50*	*82*	*83*	*86*
Aphanocomaster pulcher	X	X	X										X				
Palaeocomatella difficilis					X												
Palaeocomatella hiwia				X	X												
Phanogenia sp.									X								
Asterometra longicirra														X			
Neometra alecto									X								
Neometra xenocladia					X									X			
Aglaometra valida						X	X	X									
Cosmiometra iole																	X
Cosmiometra philippinenesis	X		X								X						
Crotalometra rustica			X							X							
Oceanometra annandalei	X		X													X	
Stenometra cristata					X							X			X	X	X
Stenometra quinquecostata					X												
Stiremetra breviradia							X										

TABLE 1. — Distribution of comatulid species by KARUBAR Expedition station. X = present.

Kepulauan Kai Stations.

Station CP 05: 05°49'S, 132°18'E, 296-299 m, 22.10.1991, fish trawl: *Aphanocomaster pulcher* (1 specimen), *Cosmiometra philippinensis* (3), *Oceanometra annandalei* (1).

Station CP 09: 05°23'S, 132°29'E, 368-389 m, 23.10.1991, fish trawl: *Aphanocomaster pulcher* (11).

Station CP 16: 05°17'S, 132°50'E, 315-349 m, 24.10.1991, fish trawl: *Aphanocomaster pulcher* (1), *Cosmiometra philippinensis* (16, probably plus 6 additional), *Crotalometra rustica* (1), *Oceanometra annandalei* (8).

Station CP 17: 05°15'S, 133°01'E, 439-459 m, 24.10.1991, fish trawl: *Palaeocomatella hiwia* (2).

Station DW 18: 05°18'S, 133°01'E, 205-212 m, 24.10.1991, dredge: *Palaeocomatella difficilis* (1), *Palaeocomatella hiwia* (2), unidentified comasterid (1), *Neometra xenocladia* (2), *Stenometra cristata* (1), *Stenometra quinquecostata* (4).

Station CP 19: 05°15'S, 133°01'E, 576-605 m, 25.10.1991, fish trawl: *Aglaometra valida* (4).

Station CP 20: 05°15'S, 132°59'E, 769-809 m, 25.10.1991, fish trawl: *Aglaometra valida* (1), *Stiremetra breviradia* (1).

Station CC 21: 05°14'S, 133°00'E, 688-694 m, 25.10.1991, shrimp trawl: *Aglaometra valida* (23).

Station DW 22: 05°22'S, 133°01'E, 124-850 m, 25.10.1991, dredge: *Phanogenia* sp. (2), *Neometra* cf. *alecto* (2).

Station CP 25: 05°30'S, 132°52'E, 336-346 m, 26.10.1991, fish trawl: *Crotalometra rustica* (1, small broken).

Station CP 27: 05°33'S, 132°52'E, 265-302 m, 26.10.1991, fish trawl: *Cosmiometra philippinensis* (1, small).

Station CP 32: 05°47'S, 132°51'E, 170-206 m, 26.10.1991, dredge: *Stenometra cristata* (1, small).

Station CP 35: 06°08'S, 132°45'E, 390-502 m, 27.10.1991, fish trawl: *Aphanocomaster pulcher* (6).

Source : MNHN, Paris

Stations between Kepulauan Aru and Kepulauan Tanimbar.

Station DW 50: 07°59'S, 133°02'E, 184-186 m, 29.10.1991, dredge: *Asterometra longicirra* (1), *Neometra xenocladia* (6).

Stations south of Kepulauan Tanimbar.

Station CP 82: 09°32'S, 131°02'E, 215-219 m, 04.11.1991, fish trawl: *Stenometra cristata* (10).

Station CP 83: 09°23'S, 131°00'E, 285-297 m, 04.11.1991, fish trawl: *Oceanometra annandalei* (31), *Stenometra cristata* (1).

Station CP 86: 09°26'S, 131°13'E, 223-225 m, 04.11.1991, fish trawl: *Cosmiometra iole* (4), *Stenometra cristata* (12).

SPECIES LIST

The following taxonomic list includes all nominal comatulid species known from the East Indian archipelago (the islands of Indonesia, Malaysia, New Guinea and the Philippines) at depths between about 100 and 1000 m. Superscript ([1]) indicates species represented in the KARUBAR collections; superscript ([2]) refers to species dredged previously around the Kai, Aru and Tanimbar Islands, but not found during the KARUBAR expedition; superscript ([3]) indicates species known from elsewhere in this region and depth range (which may be added to the eastern Indonesian outer shelf to upper bathyal comatulid fauna in the future). An asterisk (*) indicates species endemic to the Kai, Aru and Tanimbar Island area.

Species known chiefly from shallow water (<50 m) are not included [e.g., of A.H. CLARK's (1931) 81 records of *Capillaster multiradiatus* from the Indo-Malayan archipelago and the Philippines that include depth ranges, only four equal or exceed 100 m]. A few taxa with unknown depth ranges (e.g., *Parametra ajax*) have been included because all other species in their genera occur in the 100-1000-m depth range. Pre-KARUBAR records are from A.H. CLARK (1931, 1941, 1947, 1950) and A.H. Clark & A.M. Clark (1967); other sources are noted in the list.

Family COMASTERIDAE

Aphanocomaster pulcher (A.H. Clark) [1]*.

Comatulides decameros (A.H. Clark)[2] [includes *C. australis* (A.H. Clark) (Hoggett & Rowe, 1986)].

Comissia gracilipes (A.H. Clark)[2]; ?*C. horridus* (A.H. Clark)[3]; *C. luetkeni* A.H. Clark[2]; ?*C. peregrina* (Bell)[3]; *C. spinosissima* A.H. Clark[3]; *C. parvula* A.H. Clark[2].

Palaeocomatella difficilis (Carpenter)[1]; *P. hiwia* McKnight[1].

Phanogenia distincta (Carpenter)[2] [formerly *Comaster distinctus* (see MESSING, 1998b)].

Family ZYGOMETRIDAE

Catoptometra magnifica A.H. Clark[2].

Family EUDIOCRINIDAE

Eudiocrinus gracilis A.H. Clark[2]; *E. indivisus* (Semper)[2]; *E. junceus* A.H. Clark[2]; *E. ornatus* A.H. Clark[3]; *E. serripinna* A.H. Clark[2]; *E. venustulus* A.H. Clark[2].

Family HIMEROMETRIDAE

Homalometra denticulata (Carpenter)[3].

Family MARIAMETRIDAE

Mariametra vicaria (Bell)[2].

Pelometra ambonensis A.H. Clark[3].

Family COLOBOMETRIDAE

Alisometra longipinna (A.H. Clark)[3].

Source : MNHN, Paris

Cotylometra gracilicirra (A.H. Clark)[2].
Cyllometra manca (Carpenter)[3].
Epimetra nympha A.H. Clark[3].
Iconometra anisa (H. L. Clark)[2]; *I. marginata* (A.H. Clark)[3].

Family ASTEROMETRIDAE

Asterometra cristata A.H. Clark[3]; *A. longicirra* (Carpenter)[1]*; *A. mirifica* A.H. Clark[2].
Pterometra pulcherrima (A.H. Clark)[2]; *P. trichopoda* (A.H. Clark)[2].

Family CALOMETRIDAE

Calometra discoidea (Carpenter)[2].
Neometra acanthaster (A.H. Clark)[3]; *N.* cf. *alecto* (A.H. Clark)[1]; *N. diana* (A.H. Clark)[2]; *N. multicolor* (A.H. Clark)[3] (Rowe & Gates, 1995); *N. sappho* A.H. Clark[2]; *N. sibogae* A.H. Clark[3]; *N. xenocladia* sp. nov.[1]*.
Pectinometra carduum (A.H. Clark)[3]; *P. magnifica* (A.H. Clark)[3].

Family THALASSOMETRIDAE

Aglaometra valida (Carpenter)[1] [includes *A. incerta* (Carpenter), *A. propinqua* (A.H. Clark) and *A. sulcata* (A.H. Clark)].
Cosmiometra iole A.H. Clark[1]; *C. philippinensis* A.H. Clark[1]; *C. woodmasoni* (Bell)[3].
Crotalometra rustica A.H. Clark[1].
Daidalometra arachnoides (A.H. Clark)[2]; *D. eurymedon* A.H. Clark[3].
Oceanometra annandalei (A.H. Clark)[1] [includes *O. magna* (A.H. Clark)].
Parametra ajax A.H. Clark[3]; *P. compressa* (Carpenter)[2]; *P. granulata* A.H. Clark[3]; *P. lisa* A.H. Clark[2]*.
Stenometra cristata A.H. Clark[1] (includes *S. snelliusi* A.H. Clark); *S. quinquecostata* (Carpenter)[1].
Stiremetra breviradia (Carpenter)[1]; *S. perplexa* (A.H. Clark)[3].
Thalassometra gracilis (Carpenter)[3]; *T. hirsuta* A.H. Clark[3]; *T. margaritifera* A.H. Clark[3].

Family PENTAMETROCRINIDAE

Pentametrocrinus diomedeae A.H. Clark[2]; *P. japonicus* (Carpenter)[3]; *P. varians* (Carpenter)[3].
Thaumatocrinus naresi (Carpenter)[3].

Family ATELECRINIDAE

Atelecrinus wyvilli Carpenter[3].

NOTE: Specimens belonging to the following two families were collected by the KARUBAR Expedition but were not examined for this paper.

Family CHARITOMETRIDAE

Chondrometra aculeata (Carpenter)[3]; *C. robusta* (A.H. Clark)[3]; *C. rugosa* A.H. Clark[3].
Glyptometra angusticalyx (Carpenter)[3]; *G. crassa* (A.H. Clark)[2]; *G. distincta* (Carpenter)[2]; *G. inaequalis* (Carpenter)[3]; *G. investigatoris* (A.H. Clark)[2]; *G. levigata* (A.H. Clark)[3]; *G. timorensis* A.H. Clark[3]; *G. tuberosa* (Carpenter)[2].
Monachometra flexilis (Carpenter)[2]*; *M. fragilis* (A.H. Clark)[3]; *M. patula* (Carpenter)[2]; *M. robusta* (Carpenter)[2].
Poecilometra acoela (Carpenter)[3].
Strotometra ornatissimus A.H. Clark[3]; *S. parvipinna* (Carpenter)[2]; *S. priamus* A.H. Clark[2].

Family ANTEDONIDAE

Adelometra angustiradia (Carpenter)[2]*.

Source : MNHN, Paris

Antedon parviflora (A.H. Clark)[3].
Balanometra balanoides (Carpenter)[3].
Dorometra clymene A.H. Clark[3].
Erythrometra australis A.H. Clark[3].
Euantedon exquisita (A.H. Clark)[3]; *E. moluccana* (A.H. Clark)[3].
Eumetra chamberlaini A.H. Clark[3].
Fariometra alcyon (A.H. Clark)[3]; *F. dione* A.H. Clark[2]; *F. explicata* (A.H. Clark)[3]; *F. nicippe* (A.H. Clark)[3].
Iridometra maxima A.H. Clark[3].
Nanometra clymene A.H. Clark[2].
Nepiometra laevis (Carpenter)[3].
Perometra pusilla (Carpenter)[2]*.
Psathyrometra anomala A.H. Clark[3]; *P. mira* A.H. Clark[3].
Thaumatometra thysbe A.H. Clark[2].
Thysanometra tenuicirra (Carpenter)[2].
Tonrometra brevipes (A.H. Clark) [3].
Toxometra paupera A.H. Clark[3].

MATERIALS AND METHODS

Comatulids were preserved in 70% ethanol upon collection and subsequently transferred to fresh 70% ethanol or, in a few instances, dried. All specimens are deposited in the echinoderm collection of the Muséum national d'Histoire Naturelle, Paris. Catalogue numbers are prefaced EcCh. All drawings were made with a camera lucida on a stereomicroscope.

We used a caliper for linear measurements ≥1 mm, and an ocular micrometer or camera lucida for finer measurements and those difficult to make directly. We measured the length of curvilinear structures by placing a fine waxed cord along the structure (or the image of the structure under a camera lucida) and then straightening the cord along a ruler. Ray length and maximum cirrus length are rounded to the nearest millimeter. Other measurements are rounded to the nearest 0.1 mm. Measurements are included in descriptions. In addition to standard measurements (e.g., A.H. CLARK, 1950; BREIMER, 1978; MESSING, 1995a, b, 1997), we include additional morphological features that we hope will help clarify comatulid taxonomy and permit comparison with other taxa, including fossils. In particular, the large numbers of specimens of the thalassometrids, *Aglaometra* and *Oceanometra*, permit examination of morphological variation in greater detail via statistical analyses than possible for other collected taxa.

STATISTICAL ANALYSES

Statistical analyses were performed on meristic and morphometric data of *Aglaometra valida* and *Oceanometra annandalei* using STATlab version 3.0 (JAMBU, 1991-1994). Because the great majority of specimens approach full size and only a few are small, the data are not skewed; fewer than 10% of datapoints ever fall outside two standard deviations of sample means. We have therefore treated the data as normally distributed.

SOKAL & ROHLF (1995) note that, in a normal frequency distribution, $\mu \pm 3\sigma$ accounts for 99.73% of variability (where μ is the population mean and σ is the population standard deviation). The expression $(Y_i - \bar{X}) / s$ calculated for each variate Y gives the distance of each variate to the sample mean ($\bar{X}$), expressed as a multiple of s (sample standard deviation). We thus treat any data point beyond the estimated 3σ-limit as divergent and warranting re-examination.

Descriptive statistics reported for a wide range of skeletal features include minimum and maximum values, sample mean (X), standard deviation (s); and coefficient of variation ($V = (s \times 100) / \bar{X}$). We calculated the mode for cirrus traits and brachial proportions: features that generally exhibit relatively limited variation. These quantitative additions permit us to examine morphological variation in greater detail and more thoroughly and accurately compare putative taxa.

Source : MNHN, Paris

COMATULID MORPHOLOGY, MEASUREMENTS AND SYMBOLS

GENERAL FORM AND ORIENTATION

Comatulids consist chiefly of five, usually branched, feathery rays that radiate from a small central body. A central visceral mass, the **disk** (Fig. 2a), rests on the bases of the rays and bears both mouth and anus on its upper, **oral** surface. Each ray bears an open **ambulacrum**, a ciliated food groove lined with fingerlike, food-collecting podia (extensions of the water vascular system); ambulacra converge on the central mouth. The **aboral** surface of the comatulid, the side away from the mouth, consists chiefly of articulated series of calcareous endoskeletal pieces called **ossicles** (Figs 2-4). As in other echinoderms, the fine structure of the ossicles forms a fenestrated meshwork (**stereom**). Because much of comatulid taxonomy is based on detailed examination of ossicles, most observations and measurements are taken on the aboral surface. Also, because the skeleton is highly repetitive, symbols for different skeletal parts greatly condense taxonomic descriptions. The following outline of comatulid morphology and symbols (Figs 2-5) derives primarily from MESSING (1997; see also A.H. CLARK, 1915, 1921; BREIMER, 1978). Additional orientation terms include the following: **Abambulacral**: away from or opposite the surface bearing the food groove (= aboral). **Adambulacral**: toward the surface bearing the food groove. **Apical**: toward the top (aboral end) of the centrodorsal. **Basal**: toward the broader, oral side of the centrodorsal, or toward the base of a structure (= proximal). **Distal**: a direction or position away from the aboral/oral axis, or toward the tip of a structure (e.g., ray, arm, cirrus or pinnule). **Proximal**: a direction or position toward the aboral/oral axis, or toward the base of a structure.

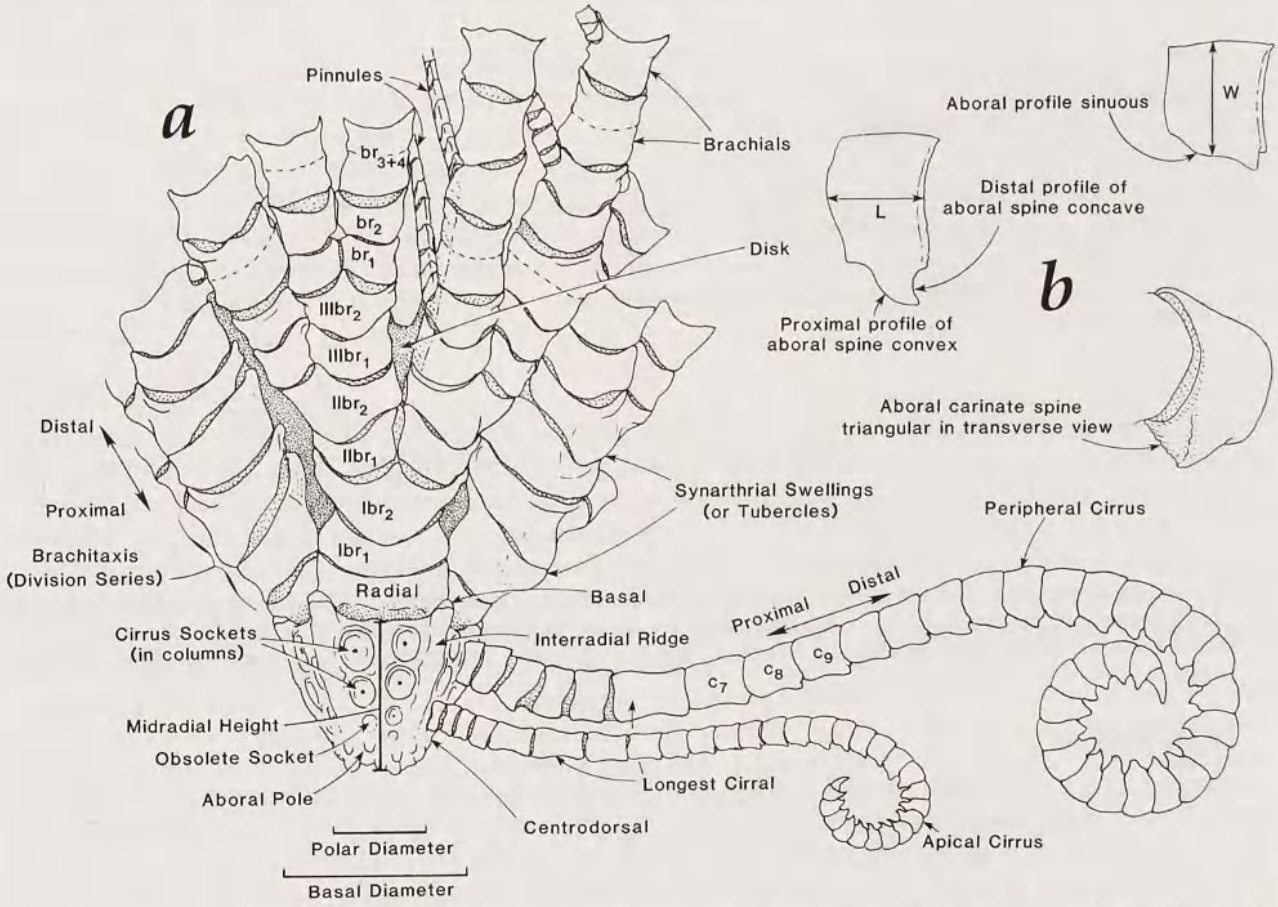

FIG. 2. — **a**, Lateral view of proximal portion of a thalassometrid showing two cirri and bases of three rays, with taxonomically important features, orientations, symbols and measurements. **b**, Three cirrus segments (cirrals) indicating measurements and selected morphological features.

Source : MNHN, Paris

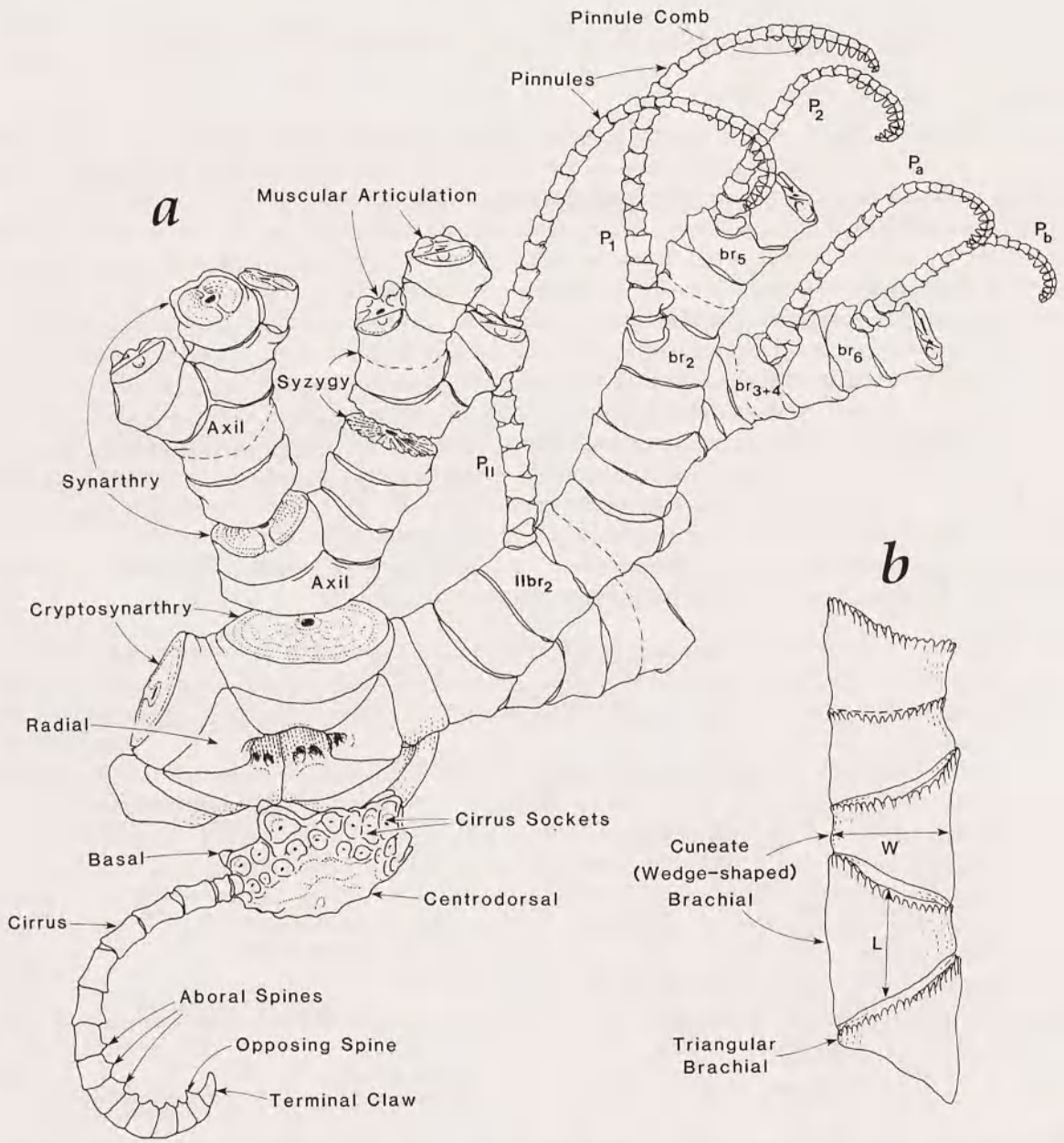

FIG. 3. — **a**, Oblique, semi-exploded view of proximal portion of a comasterid showing radial pentagon and brachitaxes of two rays (visceral mass not shown), with taxonomically important features and symbols. **b**, Portion of comatulid arm showing distinction between cuneate and triangular brachials. W and L indicate width and length measurements (from MESSING, 1997).

CENTRODORSAL

Morphology. — The **centrodorsal** is the largest skeletal ossicle, lies in the center of the aboral surface, ranges from discoidal through hemispherical to conical or cylindrical, and almost always bears numerous sockets for the articulation of hook-like, segmented **cirri** (Figs 2, 3a). [NOTE: The term centrodorsal derives from the traditional designation of the mouth-bearing surface as ventral and the opposite surface as dorsal, in agreement with most other groups of living echinoderms. However, because crinoids generally live with mouth uppermost, functional and anatomical landmarks of orientation conflict. As a result, we use the terms aboral and oral instead of dorsal and ventral].

Source : MNHN, Paris

As the centrodorsal enlarges, additional cirri are added at the margin in a double spiral pattern so adjacent sockets are offset, not side-by-side. Some species align cirri in columns from apex to margin with two or three columns under each radial often segregated by an interradial ridge. Small apical cirri developed when the comatulid was small may be retained near the centrodorsal apex, or they may be lost; traces of their attachment may remain as **obsolete sockets**. The **aboral pole**, at least a small area devoid of cirri and sockets at the centrodorsal apex, may be flat, convex or conical, smooth, papillose or spiny. In many comatulids, apical cirri are lost and their sockets obliterated with centrodorsal growth so that the aboral pole broadens and cirri are restricted to the centrodorsal margin.

Measurements. — Oral (= proximal or basal) diameter; aboral pole diameter; midradial centrodorsal height (from midradial basal margin to apex).

CIRRI

Morphology. — **Cirri** are unbranched, usually hook-like or prehensile, anchoring appendages that arise from the centrodorsal and are composed of ossicles called **cirrals** (Figs 2, 3a). The terminal segment forms a curved **terminal claw** and the penultimate usually bears an **opposing spine**. Cirrals typically increase in length from a short basal few to the longest, always in the proximal half of the cirrus, which is followed by shorter distal segments. Middle and distal cirrals may bear an aboral **carina** (=keel-like ridge), spine or transverse ridge (2b, 3a). In some taxa with dull proximal cirrals and polished, shiny distal cirrals, a distinct **transition segment** has a polished distal and a dull proximal portion.

Symbols. — Individual cirrals are indicated by an Arabic subscript counting from the base of the cirrus (e.g., c_3, c_{17}) (MESSING, 1997).

Measurements. — Number of cirri (= functional cirrus sockets), given in Roman numerals; number of cirrals (of longest cirrus), given in Arabic numerals; maximum cirrus length; number and length/width ratio (L/W) of longest cirral (Fig. 2b); position of transition cirral and of initial cirral with aboral spine or tubercle (often approximate due to gradual appearance of aboral ornamentation); number of columns of cirri adjacent to each radial ossicle (i.e., per radial area), and number of cirri per column. For *Aglaometra valida* and *Oceanometra annandalei*, the following were also recorded: longest cirral length and width, and (for *A. valida*) number of regenerating cirri. In those thalassometrids bearing numerous cirri composed of numerous cirrals, the longest cirrus and longest cirral were selected for measurement by visual estimation, rather than by measuring every cirrus.

RAYS

Morphology. — **Rays** are the five, usually branched, series of ossicles and associated soft tissues that radiate from the center of the comatulid body (Figs 2-4). A **radial** is the first (most proximal) ossicle of a ray and is associated with one of the five internal radial canals of the water vascular system that arise from the circumoral ring canal. The five radials together form a **radial pentagon** or circlet that lies against and is partly (rarely completely) covered by the centrodorsal. Structures associated with the extrapolated central axis of these ossicles are also referred to as radial. **Interradial** structures are oriented between rays. Basal ossicles lie interradially between the centrodorsal and radials but are reduced in comatulids and are not considered herein (see A.H. CLARK, 1915; BREIMER, 1978, or MESSING, 1997, for a fuller discussion).

Brachial ossicles follow the radials. **Division series** (or **brachitaxes**) are series of two to four brachials between ray branches, either following a radial and including the first ossicle at which the ray branches (**axillary** or **axil**), or following an axil and including the next. Each axil bears two articular faces distally and may thus bear two additional brachitaxes, two unbranched **arms**, or one of each. **Interior** and **exterior** arms, brachitaxes or associated structures are those closest to and furthest from, respectively, the extrapolated axis of the preceding branching series. As examples, in Figure 4, the brachitaxis labelled IIIBr4(3+4) is exterior; it arises from the outer side of the IIBr2 axil relative to the extrapolated axis of the IBr2 series. Also in Figure 4, the interior margin of br_2 is the side closest to the extrapolated axis of the preceding axil. Rays and their various branches carry extensions of coelomic, nervous and water vascular systems. Branching patterns are often diagnostic at generic and, sometimes, family levels.

Source : MNHN, Paris

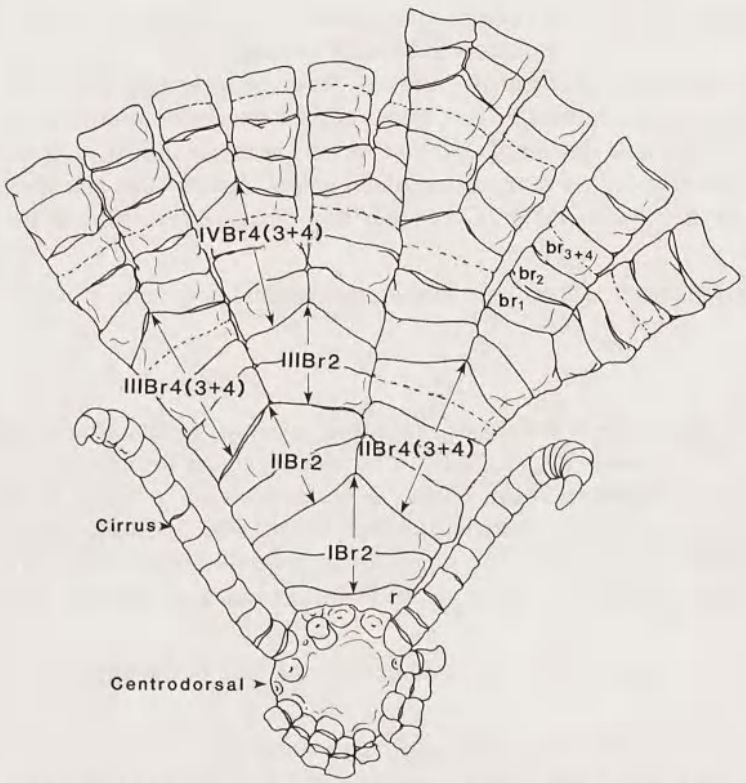

FIG. 4. — Aboral view of centrodorsal and proximal portion of a ray of a comasterid showing abbreviations for brachitaxes.

Most articulations between successive brachials are **muscular articulations**, which contain both muscles and ligaments that anchor in depressions (**fossae**) in the articular face. Moving from the ambulacral to the aboral surface, each muscular articulation consists of a pair of **muscular fossae**, a pair of **interarticular ligament fossae**, a **transverse fulcral ridge** [typically oblique (e.g., Figs 13d, 34a, 40b) except in the articulation between the radial and first succeeding ossicle in which it runs at right angles to the oral/aboral axis of the ossicle (e.g., Figs 30f, 31a)], **axial canal** and semicircular **aboral ligament fossa**. The raised area immediately around the axial canal is referred to as **periaxial**.

Syzygies are rigid, exclusively ligamentary articulations in which ridges (**culminae**) radiating from the center of one articular face correspond with those on the apposed face; the external appearance resembles a perforated line (e.g., Figs 13f, 31e). Flat areas between ridges are **crenellae**. Syzygies represent fracture points for arm autotomy and sometimes occur at diagnostic intervals along arms. They also typically occur between the third and fourth ossicles of four-ossicle brachitaxes, and between the third and fourth arm ossicles.

Synarthries bear a pair of semicircular ligaments separated by a fulcral ridge oriented through the ambulacral/abambulacral axis of the articular face (e.g., Figs 13e, 31b). The abambulacral (= aboral) surface around a synarthry may be swollen as a **synarthrial tubercle** or swelling (Fig. 2a). Synarthries join two-ossicle brachitaxes, the first two ossicles of four-ossicle brachitaxes, and the first two arm brachials. However, they may be replaced by syzygies, or (in some comasterids) modified as **cryptosynarthries**: flat articular facets bearing low irregular or concentric sculpture with only a trace of a fulcral ridge (Figs 2-3).

Brachial shape, when viewed aborally, varies from **oblong** (both lateral margins of similar length), through **cuneate** (= wedge-shaped; one lateral margin obviously longer) to **triangular** (proximal and distal margins converging on one side of the brachial) (Fig. 3b). In some species, brachitaxial and proximal arm ossicles have truncated corners that leave openings called **water pores** between adjacent rays (Fig. 5).

Brachial ossicles may be variously ornamented with spines, knobs, tubercles, teeth, crenulae or lamellae, scattered across the aboral surface or restricted to ossicle margins or a midaboral ridge or carina (Fig. 5). Brachitaxial ornamentation tends to continue onto the proximal few brachials of the unbranched arm.

Symbols. — Each successive brachitaxis is indicated by a Roman numeral followed by Br; an Arabic number following indicates the number of component ossicles (e.g., IBr2 is the first brachitaxis, always composed of two ossicles in comatulids). (NOTE: The radial is always the second ossicle counting from the first axil toward the ray base). Individual ray ossicles are indicated by br (plural, brr) followed by an Arabic subscript (e.g., IIIbr4, the fourth ossicle of the third brachitaxis; br_1, br_2, etc., for arm ossicles following the last axil). This is a slight modification of previous usage (e.g., A.H. CLARK, 1931; A.H. CLARK & A.M. CLARK, 1967) in which individual division series ossicles were indicated by Br followed by an Arabic subscript (e.g., $IIBr_2$). The change reduces possible confusion between references to entire brachitaxes (e.g., IIIBr2) and their component ossicles (e.g., $IIIbr_2$) (MESSING, 1997).

Source : MNHN, Paris

A + sign indicates a syzygy [e.g., IIBr4(3+4) is a second brachitaxis of four ossicles with the third and fourth joined by syzygy; br_{3+4} indicates brachials three and four joined by syzygy (Figs 2a, 3a, 4)]. Synarthries are not usually designated by a symbol. However, they exhibit an unusual arrangement in *Aphanocomaster pulcher* and are indicated in this species by one-em dashes [e.g., IIIBr4(1—2, 3—4) (MESSING, 1995b].

Measurements. — Arm number; ray length (from midradial margin of centrodorsal to tip of longest remaining arm, which is often broken distally); width to length ratio (W/L) of various brachitaxis and brachial ossicles, depending upon species, and diameter of br3+4. For *Aglaometra valida* and *Oceanometra annandalei*, lengths and widths of specific brachitaxis and brachial ossicles and (for *O. annandalei*) total number of axils.

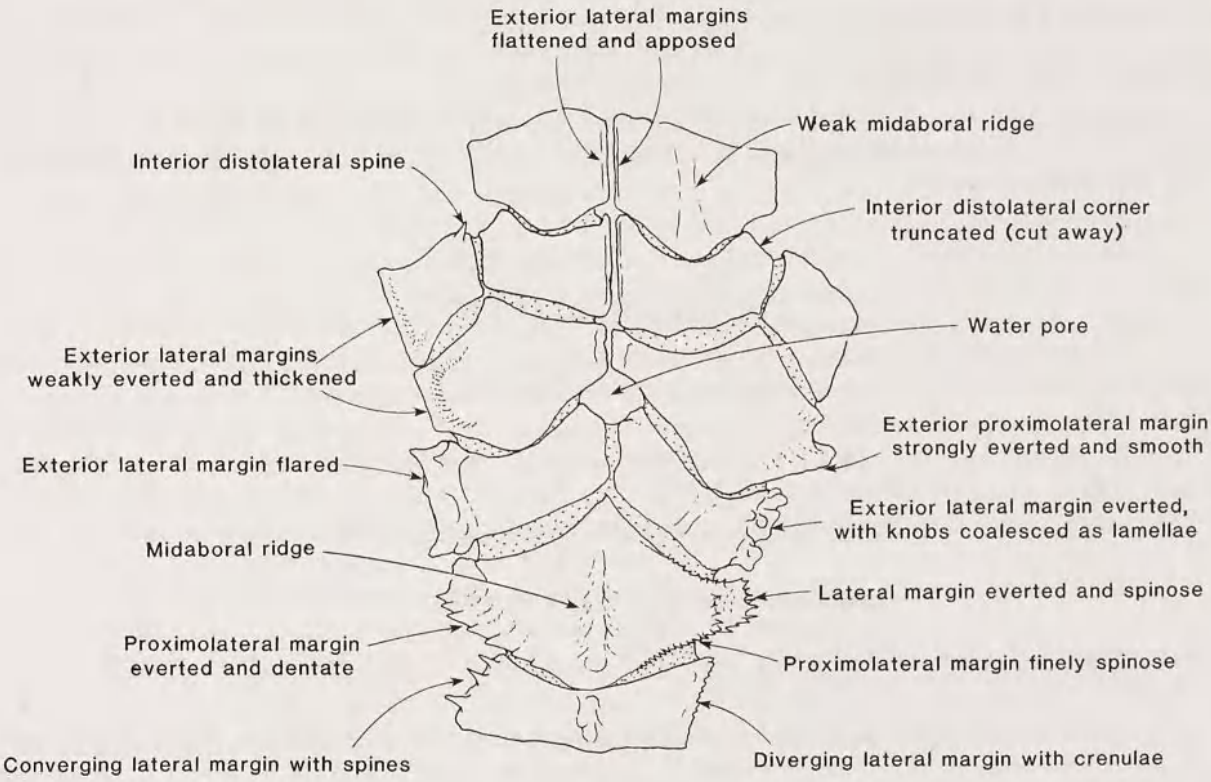

FIG. 5. — Aboral view of a series of brachitaxes of a thalassometrid identifying selected sculpture and ornamentation.

PINNULES

Morphology. — **Pinnules** are the small, segmented, unbranched appendages that arise on alternating sides of successive brachials. They are composed of ossicles called **pinnulars** (Fig. 3a), give the arms their characteristic featherlike appearance, and are the primary site of food-collection. One or more pairs of proximal **oral pinnules** often differ from those succeeding (e.g., they may be longer and more flexible, more robust and spinelike, or lack an ambulacral groove). In the Comasteridae, the distal pinnulars of oral pinnules each bear a blade or tooth that, taken together, form a **comb** (Fig. 3a). At least several pairs of **genital pinnules** bearing gonads follow the oral pinnules. These rarely exhibit skeletal modifications; they are usually either similar to or shorter and stouter than the more distal, exclusively food-collecting pinnules. Relative lengths, stoutness, numbers of pinnulars and ornamentation may be diagnostic of taxa at specific, generic and familial levels.

Symbols. — P indicates pinnules. Arabic subscript numbers and lower case letters indicate successive exterior and interior pinnules, respectively (e.g., P_1, P_2, P_a). The interior side of an arm or brachitaxis is that side closest to the extrapolated median axis of the preceding axil. In most species, br_2 bears exterior P_1, br_4 bears interior P_a (most comatulids have br_{3+4} united by syzygy; the proximal ossicle of a pair joined by syzygy or synarthry never

Source : MNHN, Paris

bears a pinnule), br5 bears exterior P_2, etc. Brachitaxes of three or four ossicles bear an exterior pinnule on the first or second ossicle, respectively, indicated by a subscript Roman numeral corresponding to the brachitaxis (e.g., P_{II} on IIBr).

Measurements. — Pinnule length and number of pinnulars of various pinnules (e.g., P_1, P_3, middle or distal pinnules); length to width ratios (L/W) of specific pinnulars.

DISK

Morphology. — The comatulid visceral mass, which rests on top of the radial pentagon and proximal ossicles of the rays, is called the **disk** (Fig. 2a). Its oral surface, the **tegmen**, is usually naked integument although it may be invested with small calcareous pieces or polygonal plates. [NOTE: Disk and tegmen are sometimes used synonymously as the oral surface of the visceral mass]. The tegmen bears the anus, located at the apex of a small **anal papilla** or tube, and the mouth with its radiating ambulacral trunks. The mouth is usually located centrally on the tegmen with the anus displaced to one side. However, in most Comasteridae the mouth is displaced off-center or to the disk margin and the anal papilla is central or subcentral. Areas on the tegmen between ambulacral grooves are **interambulacral**.

SYSTEMATIC ACCOUNT

Superfamily COMASTERACEA

Family COMASTERIDAE A.H. Clark, 1908

Genus *APHANOCOMASTER* Messing, 1995

Aphanocomaster pulcher (A.H. Clark, 1912)

Comaster pulcher A.H. Clark, 1912c: 22; 1918: 37, 40, 275, pl. 14 figs 14-15; 1931: 443, pl. 50. — GISLÉN, 1919: 14.
Aphanocomaster pulcher - MESSING, 1995b:658, fig. 1.

MATERIAL EXAMINED. — **Indonesia**. KARUBAR, *Kai Islands*: stn CP 05: 1 specimen (MNHN-EcCh 21). — Stn CP 09: 11 specimens (MNHN-EcCh 22). — Stn CP 16: 1 specimen (MNHN-EcCh 23). — Stn CP 35; 6 specimens (MNHN-EcCh 20).

DESCRIPTION. — This description emphasizes differences between the KARUBAR material and the holotype which was redescribed by MESSING (1995b).

Centrodorsal often almost circular rather than rounded pentagonal; diameter 4.6-6.6 mm., D/H 5.0-6.0. Aboral pole, especially in larger specimens, depressed, its margin formed by raised edges of apical cirrus sockets; in one specimen, pole only about half centrodorsal diameter due to numerous encroaching apical sockets.

Cirrus sockets as in holotype, but ranging from one or two high to two or three high between centrodorsal base and aboral pole (rather than in a single marginal row). Cirri more numerous than in holotype, XXXVII-LI (one specimen with LXV), 13-17 (one specimen with 18-19), 11-15 mm (most specimens 11 mm, as in holotype). Cirrals generally as in holotype, but with proximal segments often more elongated; c_1 short; c_2 and c_4 with L/W 2.0-2.6; c_3 longest, L/W 2.8-3.3. Weak transverse ridge first appearing on c_3 to c_5; developing into low rounded or blunt triangular tubercle on distal cirrals as in type, or becoming sharp triangular spine as early as c_6.

Radials barely visible as small interradial triangles, or slightly more exposed, but barely visible midradially, if at all. Articulation between Ibr_1 and Ibr_2 a cryptosynarthry in dissociated specimen. Ibr_1 very short, W/L ≥5.0. Gaps between adjacent IBr series as in type. IIBr series chiefly IIBr4(1—2, 3—4) (1-em dashes indicate ossicles joined by synarthry); a few specimens with up to four IIBr2(1—2). Variants include one each of the following on three different specimens: one IIBr4(1—2, 3+4); one IIBr1 with the single large ossicle fused interiorly to the

Source : MNHN, Paris

adjacent large IIbr$_1$; one IIBr6 with the first two ossicles apparently united by synarthry, with P$_{II}$ exterior on IIbr$_2$, IIbr$_3$ very short, an interior pinnule on IIbr$_4$ and an exterior pinnule on IIbr$_5$. IIIBr series as variable as in type: 4(1—2, 3—4), 4(1—2, 3+4), 4(1+2, 3+4), 2(1—2) and 2(1+2) apparently all present in various combinations. Occasional IVBr2 series present, usually apparently 2(1+2). Identification of the first articulation of III and IVBr series as syzygy or cryptosynarthry often difficult (see below). Pinnule-bearing brachitaxis ossicles lacking strongly projecting lateral margins found in type. Brachitaxis pinnules (i.e., P$_{II}$ and P$_{III}$) apparently arising more toward ambulacral side of ossicle than in type.

Arms 32-39; mostly broken. Ray length up to 100 mm in few remaining intact cases; br$_{3+4}$ diameter 0.9-1.2 mm on arms arising from IIIBr series. Middle and distal brr generally somewhat shorter than in type; br$_{10}$ with W/L up to 2.5; distal brr with W/L 0.75. Proximal arm syzygies generally as in the type (br$_{1+2, 3+4}$ on arms arising from IIIBr series, and br$_{3+4}$ alone on IIBr series), but are often followed by an additional syzygy at br$_{5+6}$, br$_{6+7}$ or br$_{7+8}$. At least one arm of one specimen bears br$_{3+4}$, br$_{5+6}$ and br$_{7+8}$. On one specimen, interior arms arising from IIBr2(1—2) bear br$_{1+2, 3+4}$. Arms arising from IIIBr series rarely bear br$_{1+2}$ or br$_{3+4}$ alone. Several specimens bear one to several br$_{2+3}$, usually exteriorly, with the preceding br$_1$ usually enlarged, suggesting fusion of an original br$_{1+2}$ (making br$_{2+3}$ homologous with br$_{3+4}$); br$_{2+3}$ occasionally followed by br$_{4+5}$. Following syzygy between br$_{15+16}$ and br$_{22+23}$. Distal syzygial interval usually 4, as in type.

P$_{II}$ up to 51 segments, 17 comb teeth, 19 mm; not as robust basally as in type; most pinnulars constricted and longer than median width; comb arising gradually; no partly twisted proximal tooth. On another specimen (lacking intact P$_{II}$), P$_1$ up to 54 segments, 18 teeth, 20 mm; similar to P$_{II}$ but slightly less robust; P$_2$ of 42 segments, 14 teeth, 14 mm; P$_3$-P$_5$ similar, declining slightly in size, 34-37 segments, 14-15 teeth, ~8 mm; P$_6$ 35 segments, 16 teeth, 7 mm; last comb-bearing pinnule (probably P$_8$) 25 segments, 11 teeth, 5.6 mm. On another specimen, P$_4$ 32 segments, 16 teeth, 6 mm; P$_5$ 27 segments, 15 teeth, ~4.6 mm; P$_6$ to P$_8$ last combed pinnule; first combless pinnule (P$_7$-P$_9$) 18 segments, 5.2-6.2 mm; stouter and longer than preceding, with short pinnulars; those beyond the base with a cluster of lateral spines. Gonads first well developed on P$_9$-P$_{11}$; present to at least P$_{28}$. Combs apparently arise gradually on brachitaxial and proximal brachial pinnules, and more abruptly on distal combed pinnules; initial tooth partly twisted on some combs. Some specimens with dark reddish brown granules in pinnule tissue, reminiscent of saccules but of varying size.

Disk naked; mouth central; anal papilla large, about midway between mouth and disk margin; anal interambulacral area only somewhat larger than other interambulacral areas, as in type.

Color in alcohol: Aboral pole of centrodorsal usually darker than remainder of skeleton, blotched, spotted or speckled with brown, usually in a radiating pattern. Cirrals often tan with white articulations. Proximal portions of rays often with tan or brown spots, chiefly on articulations. Disk usually gray, sometimes spotted or speckled with brown.

DISTRIBUTION. — Known only from the Kai Islands. The type specimen was recorded from *"Siboga"* station 257 in the Du-roa Straits, described by A.H. CLARK (1918: 275) as "Down to 52 metres. Coral." The KARUBAR material was retrieved from substantially deeper water: certainly 299-390 m, possibly to 502 m.

REMARKS. — MESSING (1995b) redescribed the type specimen of *Comaster pulcher* and found that its unique ray branching pattern, combined with the lack of the transverse initial comb tooth diagnostic of the genus *Comaster* as construed by A.H. CLARK (1931) and HOGGETT and ROWE (1986), required that the species be assigned to a new genus. MESSING (1998b) removed all other species of *Comaster* except the type, *C. multifidus* (Müller) [= *Comanthina variabilis* (Bell)], to *Phanogenia* Lovén.

The 19 KARUBAR specimens are the first known since the *"Siboga"* collected the holotype in 1899. Most are larger and demonstrate an even greater variability in brachitaxes composition and proximal syzygy placement. Despite a range of centrodorsal sizes, however, arm number exhibits a narrow range.

The preceding description chiefly points out differences between the KARUBAR material and the holotype. However, a relatively thick epidermis makes it difficult in some cases to distinguish between syzygies and synarthries, particularly close cryptosynarthries. To better examine problematic articulations, a small paintbrush, trimmed short to stiffen the bristles, was used to remove this epidermis from some rays of some specimens. One specimen and portions of two others, dissociated in 5% NaOCl solution, show that the first brachial syzygy

Source : MNHN, Paris

(br_{1+2}) is often incompletely developed and appears to be derived from a synarthrial articulation. They also show clearly that the IBr articulation is a tight synarthry or cryptosynarthry.

The combination of widely variable branching pattern, generalized pinnule combs, central mouth and putative saccules suggests that *A. pulcher* may represent a plesiomorphic form of Comasteridae.

Genus *PALAEOCOMATELLA* A.H. Clark, 1912

?*Palaeocomatella difficilis* (Carpenter, 1888)

Actinometra difficilis Carpenter, 1888: 93, pl. 52 fig. 2.
Actinometra pulchella (part) - Carpenter, 1888: 304, pl. 52 fig. 2.
Palaeocomatella difficilis - A.H. Clark, 1913: 2; 1918: 8, 273, pl. 11 figs 1-2; 1931: 154, pl. 7 figs 23-24. — Hoggett & Rowe, 1986: 123.
Comissia difficilis - Hoggett & Rowe, 1986: 123.

Material examined. — **Indonesia**. Karubar, *Kai Islands*: stn DW 18: 1 specimen (MNHN-EcCh 24).

Description. — Specimen fragmentary; arms lost beyond br_2 or br_3; no cirri. Centrodorsal discoidal, 4.4 mm across. Radials mostly hidden by centrodorsal. IBr2 and IIBr2 series short, aborally flattened, well separated, united by synarthry; Ibr_1 partly hidden by centrodorsal; Ibr_2 axil pentagonal with short lateral margins, W/L 2.2; $IIbr_1$ oblong, W/L 3.3; $IIbr_2$ axil similar to Ibr_2, W/L 1.8. Seven IIBr2; arms 17; all 14 arms arising from IIBr with br_{1+2}. The three exterior arms with one additional remaining ossicle also have br_{3+4}; diameter at br_{3+4} 1.2 mm. Single P_1 of 32 segments, 11 comb teeth; teeth tall and triangular, confluent with exterior side of pinnulars; initial tooth not transverse. Disk naked; mouth central.

Distribution. — Previously recorded only off Jolo in the Sulu archipelago, southern Philippines, in 256-275 m (A.H. Clark, 1931). The Karubar specimen, if conspecific, extends the range to eastern Indonesia in slightly shallower water (205-212 m).

Remarks. — This specimen most closely approaches *Palaeocomatella difficilis* (Carpenter) for the following reasons: IBr2 and IIBr2 series united by synarthry; first brachial syzygy at br_{1+2}; second brachial syzygy at br_{3+4} on all arms (three exterior) in which ossicles remain beyond br_1; no initial transverse comb tooth; mouth central. Hoggett and Rowe (1986) reassigned this species to *Comissia* on the basis of its central mouth and similar comb form. However, this comb form is the most generalized and widespread in the family, and probably represents a plesiomorphic condition. The central mouth position, characteristic of juvenile comasterids (and virtually all other comatulids) is also retained in adult comatulids belonging to *Phanogenia*, *Aphanocomaster*, *Comissia* and *Comatilia*. Also, Messing (1995a) noted that the mouth in the type specimen of *Comissia luetkeni* A.H. Clark, the type species of the genus, is subcentral, a feature also found in *Neocomatella* spp. and *Comissia* (*Leptonemaster*) *venustus* (personal observations and Hoggett and Rowe, 1986). It thus seems premature to submerge *Palaeocomatella* within *Comissia* on this basis.

Palaeocomatella hiwia McKnight, 1977

Fig. 6

Palaeocomatella hiwia McKnight, 1977: 94, figs 1-2.
Comissia hiwia - Hoggett & Rowe, 1986: 122, 124.

Material examined. — **Indonesia**. Karubar, *Kai Islands*: stn CP 17: 2 specimens (MNHN-EcCh 26). — Stn DW 18: 2 specimens (MNHN-EcCh 25).

Description of large specimen. — Centrodorsal discoidal, 6.4 mm across, D/H 4.6; aboral pole broad, slightly concave. Cirri crowded around margin, 1-2 high; XXXVIII, 18-20, 14-16 mm; several slender immature

Source : MNHN, Paris

cirri present; c_1 very short; c_2 with L/W 1.3-1.7; c_3 longest, cylindrical, L/W 2.8-3.0; following cirrals rapidly shorter, wider and compressed; c_4 L/W 1.7; c_5 L/W 1.0; distal cirrals slightly wider than long, L/W 0.8. Aboral distal tubercle well-developed on c_4, compressed and sometimes accompanied by proximal hump on c_5; following cirrals with tall, sharply compressed, longitudinal ridge occupying more than half the length of each cirral, weaker on 1-2 cirrals preceding penultimate; ridge crests flat, convex, sometimes finely denticulate. Opposing spine rounded triangular in profile. Terminal claw gently curved, longer than preceding cirral.

Radials almost completely hidden by centrodorsal, perhaps visible as small interradial triangles. All brachitaxes of two ossicles united by synarthry; IIIBr and IVBr series developed only exteriorly. IBr2 very short, partly hidden by centrodorsal; aboral surface flattened. Ibr_1 visible only interradially, in contact with adjacent Ibr_1 only proximally so that the ray bases are well separated; Ibr_2 axil pentagonal, with very short lateral margins, W/L 3.0. $IIbr_1$ short, oblong, united interiorly, W/L 3.3; $IIbr_2$ axil pentagonal, asymmetric (interior distal articular face supporting free arm not as wide as exterior face supporting IIIBr), W/L 2.3-2.5. $IIIbr_1$ longer exteriorly, W/L 2.4-2.7; $IIIbr_2$ similar to preceding axil but not as asymmetric, W/L 2.1. II-IVBr series more rounded aborally, with weak midaboral synarthrial swellings. Exterior profile of $IIbr_2$-$IIIbr_1$ and that of $IIIbr_2$-br_1 distinctly convex.

Arms 33; ray length ≅ 70 mm. On exterior arms, br_1 oblong or slightly longer exteriorly, W/L 2.0-2.3; br_2 distinctly longer exteriorly, W/L 2.0; br_{3+4} arising from IIIBr series with diameter 1.2 mm, W/L 1.5; brr_{5-8} oblong, W/L 1.5-1.6. On interior arms, br_{1+2} squarish, W/L 1.0-1.1; brr_{3-6} or br_7 oblong, W/L 1.7-2.0. Following brr rapidly becoming triangular, W/L 2.0-2.2; distal brr cuneate, W/L 1.3, longer near arm tip. Distal margins of distal brr finely denticulate. Syzygy at br_{1+2} (never br_{3+4}) on interior arms arising from II-IVBr series; at br_{3+4} on exterior arms; second syzygy br_{13+14} or br_{14+15}; distal interval 4-5.

Oral pinnules fragile, mostly broken. P_1 40 segments, 13 comb teeth, 11 mm (possibly longer); proximal several segments rhombic, wider than long; middle segments about as long as wide; comb teeth tall, triangular, incurved. P_2 32-33 segments, 10-12 teeth, 6-10 mm; middle segments with L/W up to 1.6. P_3 shorter, 27 segments, 10 teeth, 7 mm. Distal comb tooth tall, flat, broad and rounded, sometimes fan-shaped; one or two low incipient teeth sometimes preceding comb. P_4 without comb, 14 segments, 4.6 mm. Middle pinnules longer and more robust, 15 segments, 7 mm. Distal pinnules slenderer, up to 16 segments, 7.6 mm.

Disk naked; mouth large, central; anal papilla large, adjacent to mouth. Epidermis of middle and distal arms and pinnules filled with minute irregular (?calcareous) grains.

DESCRIPTION OF SMALL SPECIMEN. — Centrodorsal discoidal, diameter 3.4 mm; projecting slightly in interradial angles; aboral pole flat with central low papilla. Cirri chiefly in single crowded marginal row, occasionally two high; XXVIII, 10-11, 6.0-7.4 mm; c_1 short; c_2 L/W 1.6-1.7; c_3 longest, cylindrical with slightly expanded distal end, L/W 2.7; following segments rapidly shorter and compressed; c_5 and following cirrals as long as wide; c_4 or c_5 with low distal aboral swelling, increasing on following cirrals as subdistal to almost median triangular or rounded triangular spine, sometimes longitudinally flattened on one or two distal cirrals. Opposing spine triangular. Terminal claw gently curved, longer than preceding cirral.

Radials mostly hidden by centrodorsal; barely visible in interradial angles, but obscured by cirri. Brachitaxes all of two ossicles united by synarthry, flattened aborally, with weak midaboral synarthrial swellings. Ibr_1 extremely short, partly hidden by radials, just touching at proximal corners so that ray bases are well separated; Ibr_2 axil pentagonal with proximal margin gently concave and lateral margins short, W/L 2.8. $IIbr_1$ oblong, slightly thickened where united interiorly, W/L 2.7; $IIbr_2$ axil similar to Ibr_2 with distinctly diverging lateral margins, W/L 2.4. Exterior profile of $IIbr_2$ and br_1 distinctly convex.

Arms 20; ray length 60 mm; br_1 united interiorly and usually wider than br_2 so that bases of adjacent arms (beyond br_1) usually separated interiorly by distinct gap. On exterior arms, br_1 longer exteriorly, W/L 2.7; br_2 longer and slightly longer exteriorly, W/L 1.9; br_{3+4} diameter 1.2 mm, W/L 1.5; brr_{5-6} oblong or slightly cuneate, W/L 2.4. On interior arms, br_{1+2} longer exteriorly, W/L 1.6; brr_{3-5} oblong, W/L 2.3. Following brr rapidly becoming triangular with finely denticulate distal margins, W/L 1.8-2.1. Distal brr cuneate, W/L 1.0, longer than wide near arm tip; distal margins with stronger (but still small) triangular teeth. Syzygy at br_{1+2} on interior arms and br_{3+4} on exterior arms; second at br_{15+16} (one br_{19+20}); distal interval chiefly 4-5.

Pinnules similar to those of larger specimen, with distinctive final comb tooth. P_1 36 segments, 12 comb teeth, 10 mm. P_4 25 segments, 9 teeth, 6 mm. P_5 similar but shorter. P_6 first genital pinnule, no comb,

Source : MNHN, Paris

11 segments, 5 mm. Middle pinnules 14 segments, 6.6 mm; pinnulars following short basal two longer than wide. Distal pinnules 16 segments, 7.6 mm, slenderer with more elongated segments.

Disk absent. Irregular grains present as in large specimen, but fewer.

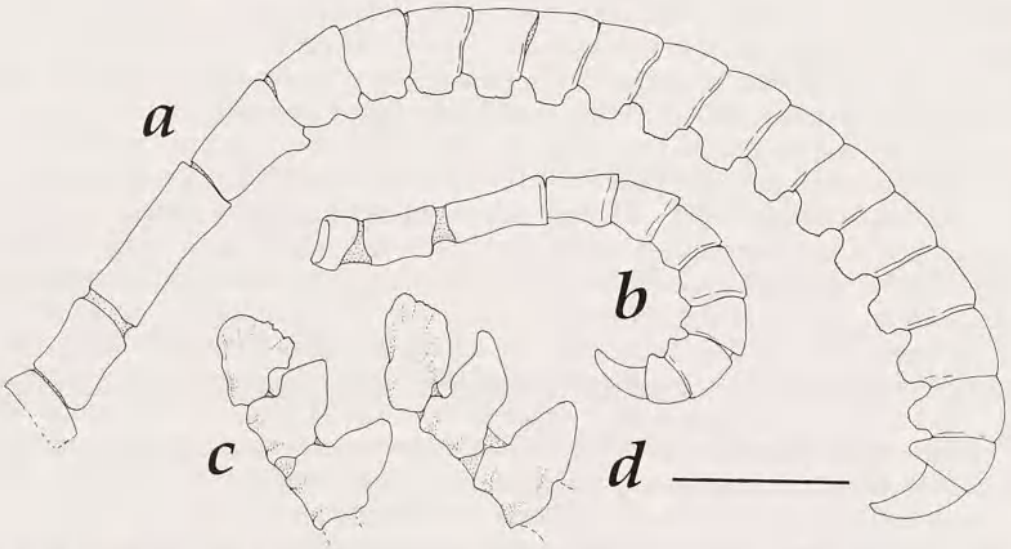

FIG. 6. — *Palaeocomatella hiwia*. **a**, cirrus, large specimen (EcCh 26); **b**, cirrus, small specimen (EcCh 26); **c-d**, comb tips showing fan-like terminal pinnular (c, P_1; d, P_2). Scale bars: a-b = 1.0 mm; c-d = 0.25 mm.

ADDITIONAL POSSIBLE SPECIMENS (stn 18). — Centrodorsal discoidal; diameter 2.4 mm; cirri in single marginal row, similar to those of smaller specimen above (with weaker aboral ornament), XVII-XXI, 7-8, 2.4 mm; c_3 longest, L/W 2.3-3.0; weak, slightly longitudinally flattened, triangular aboral spine on distal one or two cirrals. Radials hidden in aboral view; Ibr_1 at least partly hidden by centrodorsal. Arms 10, all broken. Final comb tooth of few remaining oral pinnules apparently tall, broad and rounded.

DISTRIBUTION. — The only previously published records are from off East Cape, North Island, New Zealand, in 602-808 m (possibly 432-924 m), and the Kermadec Islands in 542-545 m (McKnight, 1977). The KARUBAR collection, if conspecific, extends the range to eastern Indonesia in at least 212-439 m (possibly 205-459 m).

REMARKS. — The large specimen conforms closely to MCKNIGHT's (1977) original description of *P. hiwia*, but is substantially larger. The type material has centrodorsal diameters of 3-4 mm; cirri XVIII-XXIX, 15-20, 10 mm long; arms 16-20; P_1 of 25-30 segments with 8-9 teeth; combs extending to P_3, and was collected in 432-688 m. The smaller specimen falls well within the range of variation exhibited by the type material, but lacks the well-developed aboral, longitudinal cirral ridge. The slight longitudinal compression of the distal cirral spines is atypical of other comasterids and is interpreted here as an early developmental stage of the longitudinal ridge found in the large specimen and type material. Both KARUBAR specimens lack second syzygies at br_{4+5} or br_{5+6} on interior arms as described by MCKNIGHT (1977).

The two additional small, fragmentary specimens from station 18 are very tentatively assigned here because they appear similar in several respects to the smaller of the two specimens from station 17, despite being collected in substantially shallower water.

Genus ***PHANOGENIA*** Lovén, 1866

Phanogenia sp.

MATERIAL EXAMINED. — **Indonesia**. KARUBAR, *Kai Islands*: stn DW 22: 2 specimens (MNHN-EcCh 27).

Source : MNHN, Paris

DESCRIPTION. — Two small specimens, a and b, as follows. Centrodorsal diameter: a, 1.6 mm; b, 1.4 mm. Cirri: a, XIV, 8-10, 3.4-5.0 mm; b, XXVII, 10, 6.0-6.4 mm. c_3 (and sometimes c_4) longest, L/W 2.9-3.3. Arms: a, 16; b, 14-17 (3 rays detached or lost, 1 ray broken). Ray length: a, 25 mm; b, 45 mm. Combs present to P_3-P_5, sometimes one or two at intervals beyond; combs with transverse initial tooth. IBr2 united by synarthry. Each specimen with one ray in which the articulations between the third and fourth ossicles of the IIBr series and between br_1 and br_2 on both succeeding arms appear to be a cryptosynarthry or incompletely developed syzygy with few, if any, culminae. Otherwise, several IIBr4(3+4) series and (in specimen a) one interior IVBr2 (articulation tight, irregularly perforated) series present, and first brachial syzygy at br_{1+2}.

REMARKS. — MESSING (1998b) recently transferred all species previously included in *Comaster* Agassiz except the type species, *C. multifidus* (Müller), to *Phanogenia*. The two KARUBAR specimens most closely approach *Phanogenia serrata* (A.H. Clark), previously recorded only from Japanese waters [as *Comaster serratus* (A.H. Clark, 1931)]. A.H. CLARK's key is misleading here because he diagnoses *P. serrata* as having 30 arms (p. 413, 452), but then goes on to describe specimens with 13, 15 and 28 arms as well. MESSING (1998b) removed A.H. CLARK's other very small *Comaster*, *C. tenellus* A.H. Clark, to *Comanthus*.

The KARUBAR specimens probably represent juveniles of one of several cirrus-bearing species of East Indian *Phanogenia* (e.g., *P. novaeguineae* [Müller], *P. multibrachiata* [Carpenter], *P. fruticosa* A.H. Clark, *P. schoenovi* A.H. Clark or *P. distincta* [Carpenter]) that may represent a growth series (perhaps including *P. serrata* as well). It is thus not clear which species name should be applied.

Unidentified comasterid

MATERIAL EXAMINED. — **Indonesia**. KARUBAR, *Kai Islands*: stn DW 18: 1 specimen (MNHN).

DESCRIPTION. — Centrodorsal discoidal; diameter 3.8 mm. Cirri in single marginal row, XXIX, 10-11, 8 mm; c_3 longest, L/W 3.1. Arms 11; one IIBr2; br_{1+2} on interior arm, br_{2+3} on exterior arm.

REMARKS. — Possibly *Palaeocomatella* sp. with an abnormal exterior arm, or *Capillaster* sp.

Superfamily TROPIOMETRACEA

Family ASTEROMETRIDAE Gislén, 1924

Genus *ASTEROMETRA* A.H. Clark, 1907

Asterometra longicirra (Carpenter, 1888)

Fig. 7a

Antedon longicirra Carpenter, 1888: 103, pl. 17.
Asterometra longicirra - A.H. CLARK, 1947: 439. — A.M. CLARK, 1972: 152.

MATERIAL EXAMINED. — **Indonesia**. KARUBAR, *Tanimbar Islands*: stn CP 50: 1 specimen (MNHN-EcCh 28).

DESCRIPTION. — Centrodorsal conical with almost straight proximal sides; diameter 5.8 mm; D/H 1.1. Pole with five small radially arranged apical tubercles. Cirri XVI, none complete; longest remaining of 62 segments, 90 mm long (tip missing; attached portion 12 segments, detached fragment 50 segments); cylindrical proximally, compressed distally; c_1 short, wider (transversely, across articulation) and taller (along the oral-aboral axis) than following segments; c_{13} or c_{14} to about c_{20} longest, L/W 1.4; distal aboral edge first projecting on c_{27}, becoming small sharp distally-directed spine by c_{30}. Spine becoming a transversely thickened, rounded carina on shorter distal segments.

Source : MNHN, Paris

Radials almost flat, some with elongated midaboral tubercle, W/L 3.1. IBr2 sharply flat-sided and apposed; Ibr_1 with elongated midaboral ridge, W/L 2.5; ridge smooth and straight, with irregular crest or divided into two or three tubercles; Ibr_2 axil with elongated midaboral tubercle (one axil has a second smaller tubercle on aboral midline adjacent to one distal articulation), W/L 1.7.

Arms 10; ray length 105 mm (measured from centrodorsal apex)(arm tips lost). Brachials with lateral margins narrowly everted and flat-sided to about br_9; adjacent arms closely apposed to about br_4; everted lateral margins on brr_{5-9} appearing as narrow flanges in aboral view; br_1 and br_2 each with elongated midaboral tubercle, weaker than on IBr; br_{3+4} very short, W/L 2.3, diameter 3.2 mm; br_5 to br_8 short and oblong, W/L 3.1. Following brachials strongly cuneate by br_{13} or br_{14}, W/L 2.5-3.0; low narrow midaboral ridge first appearing on br_{11}. Middle brachials laterally compressed, cuneate with stronger midaboral ridge. Distal brachials short, more strongly compressed, carinate, W/L 1.7; carina ranging from low and rounded to high and fin-shaped.

Most pinnules broken; all strongly carinate. P_1 12 segments, 7.6 mm long. P_2 stouter, 13 segments, 9.6 mm. P_3 and P_4 similar to P_2, both of 12 segments, 10.0 and 7.6 mm, respectively. Small spine present on distal end of carinate margin of distal segments on P_2 and following pinnules. Distal pinnules up to 20 segments, 16.5 mm long; longest middle segments with L/W to 1.7.

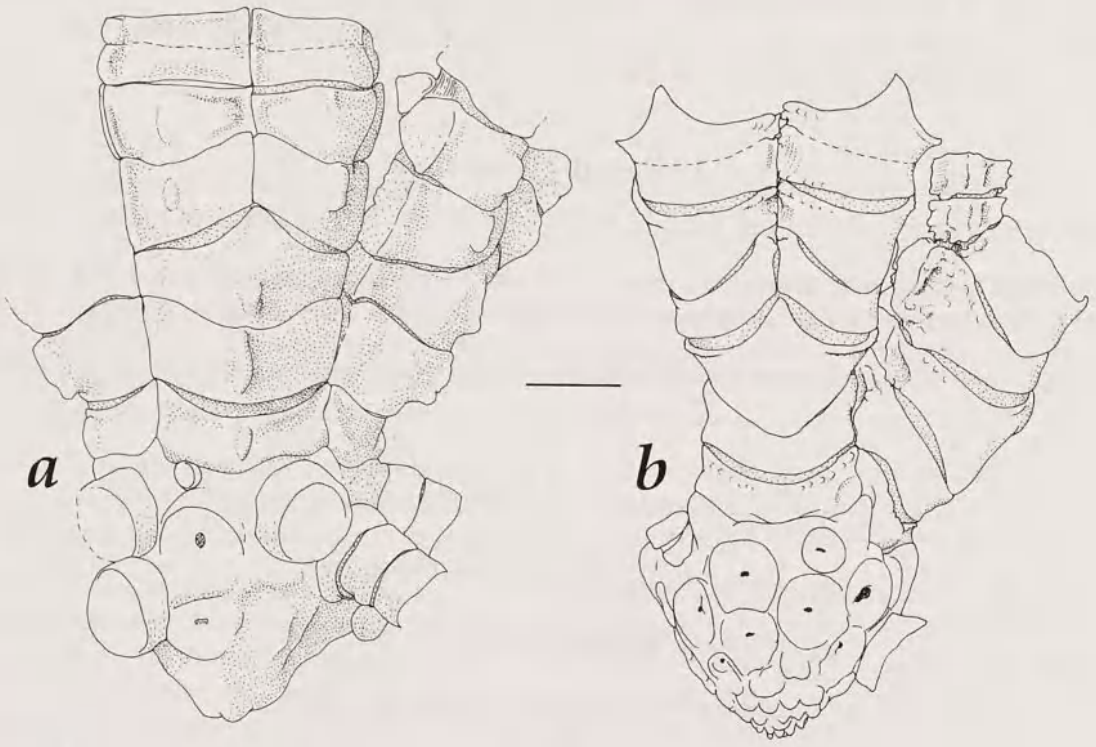

FIG. 7. — **a**, *Asterometra longicirra* (EcCh 28), centrodorsal, bases of several cirri and bases of three rays. **b**, *Crotalometra rustica* (EcCh 42) small specimen, centrodorsal, bases of two cirri and bases of two rays. Scale bar = 2.0 mm.

DISTRIBUTION. — *A. longicirra* was recorded previously only from the Kai Islands in 90-256 m (A.H. CLARK, 1931). The KARUBAR specimen from Tanimbar falls within this depth range (184-186 m).

REMARKS. — *Asterometra mirifica* A.H. Clark, *A. cristata* A.H. Clark, *A. macropoda* (A.H. Clark) and *A. longicirra* (Carpenter) "differ very little except in the extent and degree of the proximal carination" (A.H. CLARK, 1947: 433). Previous experience suggests that, when A.H. CLARK admits that two or more species are very similar, they are likely synonymous. The KARUBAR specimen is identified as *A. longicirra* because the aboral carina 1) is not obviously as prominent or continuous as in *A. mirifica* or *A. cristata*, 2) appears stronger

Source : MNHN, Paris

than described for *A. macropoda*, 3) may be reduced to one or more tubercles as in A.H. CLARK's description, and 4) resembles the figure of the type in CARPENTER (1888, pl. 17). Also, the single axil with two tubercles on the KARUBAR specimen approaches most closely the three-tubercle axils described for *A. longicirra*. YULIN (1984: 109) describes three specimens of *A. mirifica* from south of Hainan Island as having "a high, thin median carination, the crest of which is strongly convex in lateral view". Although the clearly convex and continuous carinae in the accompanying figure are typical of that species, they are distinctly weaker than in the KARUBAR specimen.

A. longicirra is the senior synonym among the four names. However, we do not formally synonymize any of the four nominal species pending examination of additional material. The aboral spines on the cirri immediately distinguish the KARUBAR specimen from the other ten-armed asterometrid genus, *Sinometra* (Yulin, 1984).

Family CALOMETRIDAE A.H. Clark, 1912

Genus ***NEOMETRA*** A.H. Clark, 1912

REMARKS. — The genus *Neometra* currently consists of nine species distinguished on the basis of arm number and ornamentation, relative lengths of cirri and cirrals, and cirrus ornamentation. Examination of material referable to eight of these (including type material of six) suggests that several may not represent distinct taxa. For example, a comparison of syntypes of *N. gorgonia* A.H. Clark (USNM 35556) and *N. conanimis* A.H. Clark (USNM 35559) indicates that the two are very similar and probably synonymous. Both are endemic to western Australia, have broadly overlapping bathymetric ranges (ROWE & GATES, 1995), and were originally described from material collected together (A.H. CLARK, 1947). *N. gorgonia* is larger, with longer cirri and more arms. Perhaps its diagnostic pair of flanking aboral cirral carinae develop only once specimens reach a larger size than those identified as *N. conanimis*.

The specimens described below as *N.* cf. *alecto* belong to a group of imperfectly distinguishable species that differ chiefly in the nature and strength of their brachial ornamentation. They are discussed following the description.

Some confusion also exists at the generic level. A.H. CLARK (1947) distinguished *Neometra* from *Gephyrometra* A.H. Clark chiefly as follows: in the former, interradial extensions of the radials are broad and "entirely and usually rather widely separate the bases of [adjacent] IBr_1" (= Ibr_1) (p. 355); in the latter, the extensions are undeveloped or narrow and the bases of adjacent Ibr_1 meet distal to them. However, in several specimens of *N. multicolor*, including the holotype (USNM 22619, 35452, 35465), the interradial extensions are very narrow, and the proximolateral corners of adjacent Ibr_1 are barely separated or actually meet beyond the radials. Similar variations exist in a syntype of *N. conanimis* (USNM 35559).

We offer no formal revision of the genus due to the relatively small number of specimens examined. Data in ROWE and GATES (1995) (e.g., first records of *N. diana* and *N. multicolor* from Australian waters; range extensions of *N. conanimis* and *N. gorgonia*) indicate that substantial new material exists that should be examined before the genus can be adequately revised. However, the KARUBAR collection also includes eight specimens that differ so much from known *Neometra* species that they require recognition as a new species.

Neometra cf. ***alecto*** (A.H. Clark, 1911)

Fig. 8

Calometra alecto A.H. Clark, 1911a: 544.
Neometra alecto - A.H. Clark, 1947: 367.

MATERIAL EXAMINED. — **Indonesia**. KARUBAR, *Kai Islands*: stn DW 22: 2 specimens (MNHN-EcCh 30).

DESCRIPTION. — Centrodorsal discoidal; diameter 2.9-3.5 mm. Pole smooth, flat or slightly conical, with traces of obsolete sockets around margin. Cirri XI-XII, 30-44, longest 21mm, in single marginal row; all

Source : MNHN, Paris

segments short, c_5-c_7 longest, L/W 1.0-1.3 (on small cirrus of 30 segments, c_4-c_6 longest, L/W 1.7-1.8). Aboral process first appearing on c_4 to c_6 as distally-directed spine (sometimes transversely widened). On c_{12}-c_{15} and following segments, spine lengthens along cirral axis as a curved, distally sharp carina, shortening to a compressed blunt spine on distal very short cirrals; distal few cirrals about as long as broad. Opposing spine large, blunt triangular, compressed.

Rays narrow, well separated; aboral surface at least weakly carinate beyond radials. Radials short midradially with truncated triangular interradial extensions separating adjacent Ibr_1. Rays bear two IIBr2, one IIBr2 and one free arm, or two free arms. Lateral adambulacral margins of IBr ossicles bear thin flanges, with margins converging distally; lateral flanges absent on IIBr2; proximal third to half of $IIbr_1$ united interiorly. In larger specimen, weak narrow midaboral ridge strongest at synarthry on IBr series, terminating in tubercle at one or both distal margins of Ibr_2 and $IIbr_2$ axils; one IBr2 series almost smooth. Smaller specimen (lacking mature IIBr series) with a thin, bluntly dentate midaboral ridge running from middle of Ibr_1 to middle of axil.

Arms 12 to 18 or, possibly, 19; ray length to at least 80 mm; brr_{1-2} with midaboral ridge strongest at synarthry (sometimes strong and dentate on smaller specimen); br_2 expanded exteriorly for attachment of enlarged base of P_1; expansion reduced on br_4; br_1 through br_4 or br_5 oblong. Following brr cuneate, almost triangular by about br_{13}, strongly cuneate again by about br_{20}, and gradually less cuneate distally. Distal margin of each br following br_2 with narrow, distally-directed, sometimes spout-like, spinose projection, midaboral on brr_{1-6}, offset to longer side of following brachials, weaker and spinelike on distal brachials.

P_1 up to 31 segments, 8 mm, but sometimes much smaller and weaker. First segment greatly enlarged, convex, produced on side toward arm tip as thin curved carina; second segment much smaller, thick, short, with converging lateral margins, W/L 2.6; following segments small, short and cylindrical. $P_2 \approx 17$ segments, to 14 mm long, with small spines at distal corners of distal segments; enlargement of first segment much less than on P_1, with thin rounded carina on side of basal two segments facing arm tip. One arm with P_1 and P_2 similar, small, flexible and slender. P_3 similar to P_2 or longer, stiffer and slightly more robust, up to ≈ 19 segments, 15 mm long, with spines at distal corners of all but basal two segments. Following pinnules gradually decreasing in length and number of segments; carina on basal two segments lost by P_{4-5}; P_8 14 segments, 10 mm long; middle pinnules of 15 segments, 10.3 mm long. Proximal pinnules taper over their entire length. Middle pinnules more straight-sided, tapering mostly over shorter distal segments so that these pinnules appear more robust. Middle and distal pinnules often with several short thin distal segments. Pinnules in the smaller specimen as follows: P_1 25 segments, 6.5 mm; P_2 and $P_3 \approx 15$ segments, 12 mm (tips broken); $P_8 \approx 8.5$ mm; middle pinnule (P_n) 17 segments, 10.5 mm; distal pinnule to 19 segments, 10.9 mm.

No disk.

Color (in alcohol). Cirri banded brown and white; centrodorsal and brachitaxes white; brachials yellow midaborally, purplish brown laterally, white at pinnule bases; with occasional pairs of brachials white; pinnules banded white and pale brown.

DISTRIBUTION. — Previous records extend from the Lesser Sunda Islands, Indonesia, to the Philippines and east of Hainan I., China, in 77-208 m (A.H. CLARK, 1931). The KARUBAR collection falls within this depth range, but extends the distribution eastward to the Kai Islands.

REDESCRIPTION OF THE HOLOTYPE OF *N. alecto*. — (USNM 27494, 10°10'40"N, 124°02'45"E, 77 m, Bohol Straits, Philippines, *"Albatross"* sta. 5414, 24 March 1909). This redescription emphasizes differences between the KARUBAR specimens and holotype.

Larger than the KARUBAR specimens. Centrodorsal diameter 5.0 mm. Cirri XV, 44, longest 27.6 mm; c_{6-7} longest, L/W 1.0-1.1. Triangular interradial extensions of radials not truncated. Lateral adambulacral flanges weakly developed and only slightly converging. Adjacent $IIbr_1$ united interiorly for most of their length, with distolateral margins convex rather than concave as in the KARUBAR specimens; $IIbr_2$ axil lacking distal tubercles. Brachials almost triangular by brr_{9-11}, remaining triangular to about mid-arm; distal brr short and cuneate, W/L 1.8-2.0; brr_{1-2} with a rounded synarthrial swelling; midaboral distal margins of brr_{2-7} flared and spinose, but not as strongly as in the KARUBAR specimens. Flared distal margins subsequently slightly overlapping next brachial,

Source : MNHN, Paris

weakening and sometimes disappearing on distal brr, not spinelike as in KARUBAR specimens. On P_2, distal margins of distal segments rimmed with spines. Middle pinnules of up to 17 segments. Distal segments of middle and distal pinnules with stronger distal spines than in KARUBAR specimens. Color pattern similar to that of KARUBAR material, but some pinnules entirely brown or white; no paired white brachials.

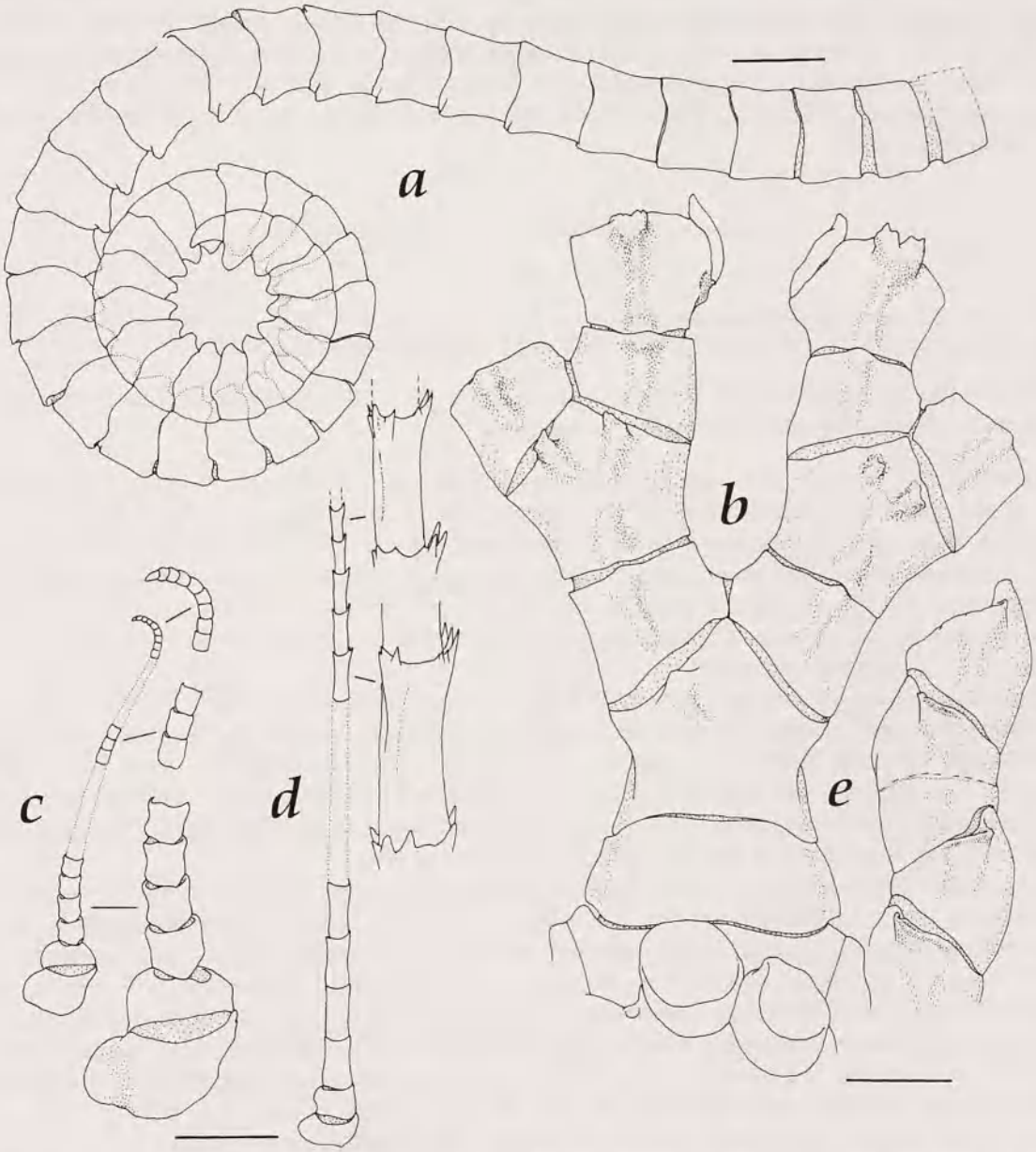

FIG. 8. — *Neometra* cf. *alecto* (EcCh 30): **a**, cirrus (shown in two sections; the distal several cirrals of the proximal section are viewed slightly obliquely); **b**, aboral view of base of one ray; **c**, P_1; **d**, P_2; **e**, aboral view of five middle brachials. Scale bars: a = 1.0 mm; b, e = 1.0 mm; c, d = 2.0 mm; enlarged pinnulars of c = 1.0 mm; enlarged pinnulars of d = 0.5 mm.

REMARKS. — Differences between the holotype of *N. alecto* and the KARUBAR specimens appear largely related to size and ornamentation. Similar variations between these and other *Neometra* species blur current diagnostic distinctions. For example, the low alternating spinelike projections on the distal brachials of the KARUBAR specimens are better developed than in the holotype of *N. alecto*, but are as described in the type of

Source : MNHN, Paris

N. spinosissima (A.H. Clark, 1947: 365). *Neometra diana* (A.H. Clark) and *N. sappho* A.H. Clark differ from *N. alecto*, *N. conanimis* A.H. Clark, *N. spinosissima* and *N. multicolor* (A.H. Clark) in having relatively longer cirrals (i.e., L/W of longest cirrals about 2.0 versus 0.7-1.1). However, the KARUBAR specimens span much of this range: longest cirral L/W is 1.0-1.3 on large cirri and 1.7-1.8 on a smaller cirrus.

Neometra diana supposedly differs from all other species in the genus in having very tall, narrow synarthrial swellings clearly visible in photographs of the type specimen from *"Siboga"* station 294 (A.H. CLARK, 1947, pl. 37, figs 195-196). However, in syntypes from the same station (USNM E476, 3 specimens), these swellings are only weakly to moderately developed, and the IBr series are similar to those of the KARUBAR *N.* cf. *alecto* minus the latter's distal axil tubercles. Further, one *N. diana* syntype bears a pair of distal tubercles on the axil of a regenerating IIBr series.

Neometra xenocladia C. G. Messing, sp. nov.

Fig. 9

MATERIAL EXAMINED. — **Indonesia**. KARUBAR, *Kai Islands*: stn DW 18: 2 specimens (MNHN-EcCh 32). — *Tanimbar Islands*: stn DW 50: 1 specimen (MNHN-EcCh 31); 5 specimens (MNHN-EcCh 33).

TYPES. — The specimen (MNHN-EcCh 31) collected at stn DW 50 is the holotype. The 5 other specimens (MNHN-EcCh 33) collected at the same station are paratypes.

DESCRIPTION OF HOLOTYPE. — Centrodorsal a slightly convex disk; diameter 4.6 mm. Cirri XIX, 29-34, longest 21 mm, in partly double marginal row; c_{7-8} longest, L/W 1.0; following cirrals decreasing in length; distal cirrals much wider than long. Proximal cirrals beyond basal three or four wider distally and weakly carinate aborally (sometimes also orally); aboral carina gradually increasing in height, occupying entire length of cirral, and becoming curved, distally pointed and sharp; on distal several cirrals it becomes a shorter, compressed, distally-directed carinate spine, sometimes tonguelike or triangular. Opposing spine larger than preceding spines, triangular, fat but somewhat compressed.

Radials short midradially; interradial extensions long, tonguelike, parallel-sided.

Remaining four rays (including one detached) bearing two IIBr2 each. Adjacent IBr2 separated, with low narrow midaboral ridge; Ibr_1 short, with diverging lateral margins thinning toward distolateral corners, W/L 3.1; Ibr_2 axil with parallel or converging, thin, flanged adambulacral margins, W/L 1.8. IIBr2 ossicles about as long as those of IBr2, with adambulacral flanges absent or narrow; adjacent $IIbr_1$ united proximally, W/L 1.7; rounded synarthrial swelling extending from middle of $IIbr_1$ to middle of $IIbr_2$ axil; axil W/L 1.5.

Arms probably 20 (4 on each of 4 remaining rays); ray length = 80 mm; brr_{1-2} both slightly longer exteriorly with rounded midaboral synarthrial swelling extending from middle of br_1 to at least middle of br_2; br_1 mostly united interiorly, W/L 1.7; br_2 with large exterior convexity to accommodate enlarged proximal segment of P_1, W/L 1.3; br_{3+4} 1.3 mm across, W/L 1.1; br_5 oblong, W/L 1.7. Following brr cuneate, W/L 1.3-1.4, with low midaboral ridge that widens distally on each brachial and becomes offset to longer side of brachial by brr_{6-7} (so that ridge appears gently zigzag or sinuous); distal margins raised and smooth, overlapping next brachial slightly or not at all. Brachials triangular or almost so by br_8, W/L 1.2; cuneate again by mid-arm, W/L 1.4; low offset aboral ridge still present. Distal brachials short, strongly cuneate, with very low aboral ridge, W/L 1.6. First syzygy at br_{3+4}; second at br_{13+14} to br_{17+18}; next interval five; distal interval chiefly four (some five).

P_1 34 segments, 8.4 mm; first segment greatly enlarged, projecting toward arm tip as huge, thin, convex, fanlike expansion; second segment short, half as wide as first, with converging lateral margins, W/L 2.5; following segments abruptly much narrower, short and cylindrical. P_2 23 segments, 8.8 mm; as thin as P_1 but stiff and straight; expansion of first segment smaller than in P_1; second segment as in P_1; third segment squarish; following segments longer than wide, carinate (i.e., triangular in cross-section), gradually shorter and thinner distally; middle segments with L/W 3.0; middle and especially distal segments with spines at distal corners. P_3 19-22 segments, 10.1-11.6 mm; similar to P_2 but thicker, more robust, stiffer and spinelike; expansion of first segment weaker than in P_2, but second segment moderately expanded; third segment longer than wide; distal segments with strong distal spines, max. W/L 3.6; distal one or two to several segments short. P_4 similar to P_3

Source : MNHN, Paris

but all tips broken. Subsequent pinnules gradually decreasing in length, similar to P_4 but more strongly carinate and tapering only near tip; P_7 16 segments, 7.4 mm; P_{10} 19 segments, 8.2 mm; carina on basal two segments disappearing by P_{5-6}. Distal pinnules longer, more slender and flexible than middle pinnules, but generally similar, with several short distal segments; up to 21 segments, 11 mm.

Disk missing.

Color (in alcohol). — Centrodorsal and IBr series yellow, cirri banded brown and yellow, IIBr series and arms purplish-brown, pinnules purplish-brown, some with yellow tips.

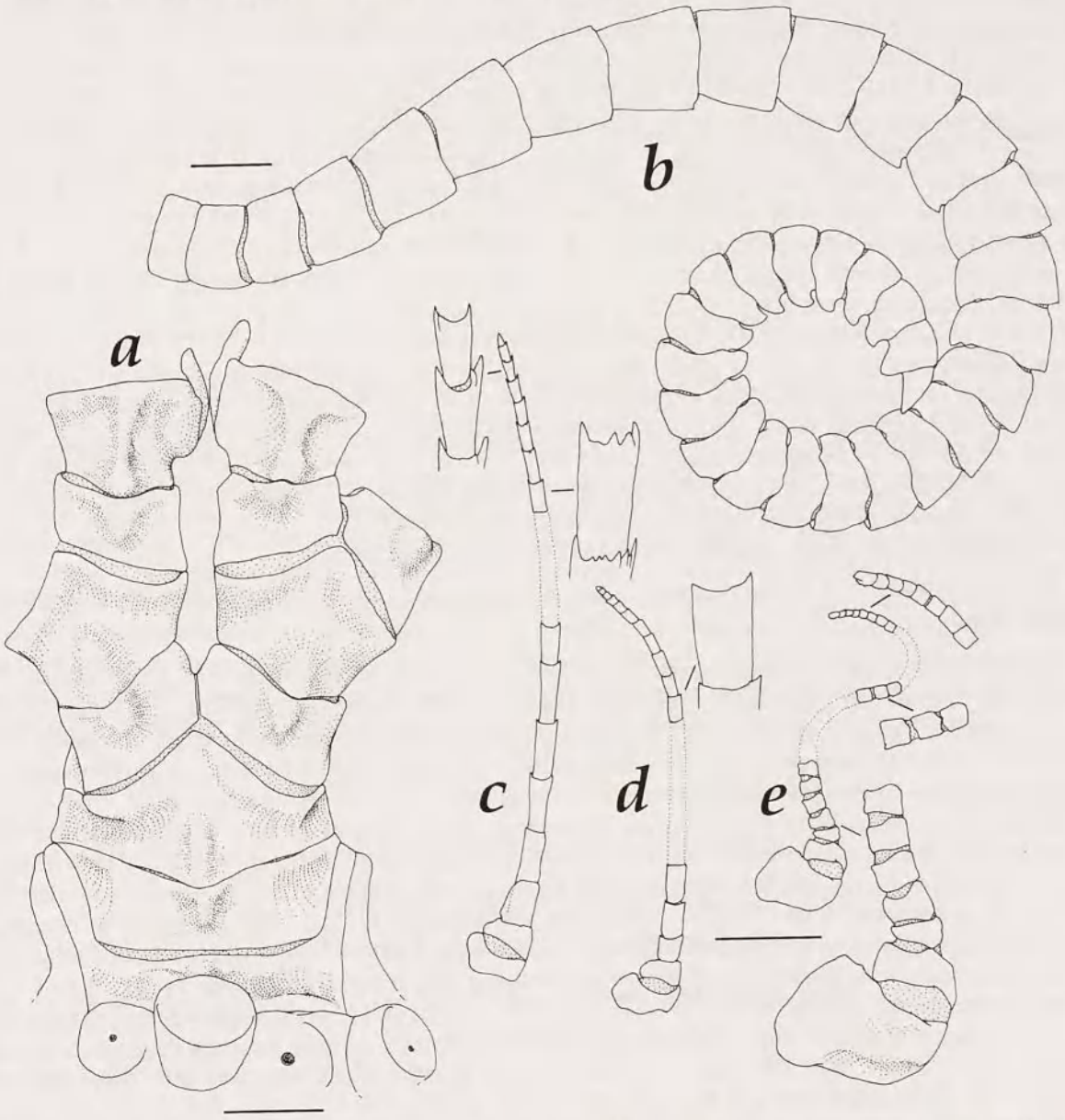

FIG. 9. — *Neometra xenocladia* sp. nov., holotype (EcCh 31): **a**, aboral view of base of one ray; **b**, cirrus; **c**, P_3; **d**, P_2; **e**, P_1. Scale bars: a = 1.0 mm; b = 1.0 mm; c-e (lower right bar) = 2.0 mm; enlarged pinnulars = 1.0 mm.

VARIATIONS IN OTHER SPECIMENS. — Centrodorsal discoidal or rounded pentagonal; diameter 3.1-4.6 mm; pole flat or slightly convex. Cirri XI-XVII, 22-42 (chiefly 30-36), longest 14-26 mm (chiefly ≥ 21 mm), in single or partly double marginal row. One to four successive segments between c_5 and c_{10} (e.g., c_6, c_{5-8}, or c_{7-10})

Source : MNHN, Paris

longest, L/W 1.0-1.4. Aboral carina sometimes terminating in a small distal spine on c_{7-9}. Carinate spines on distal cirrals occasionally blunt.

Radials sometimes with midradial tubercle; interradial extensions occasionally with slightly converging sides, sometimes extremely narrow.

Midaboral ridge on IBr series sometimes low and rounded; Ibr_1 W/L 2.8-4.2; lateral margins of Ibr_1 rarely with thin, variably shaped (e.g., tongue- or ear-like), adambulacral flange extending distal to interradial extensions of radials; Ibr_2 axil with W/L 1.4-1.8. One or two IIBr2 per ray; $IIbr_1$ W/L chiefly 1.5-1.6 (to 1.9); $IIbr_2$ axil with synarthrial swelling weak or strong and rounded, W/L chiefly 1.3 (to 1.7). IIIBr2 developed interiorly, when present, similar to preceding brachitaxes but completely rounded laterally without adambulacral flanges.

Arms 10-21; ray length 50 to at least 80 mm (broken in most specimens); brr_{1-2} oblong or longer exteriorly; br_1 W/L chiefly 1.7 (1.5-2.0); br_2 W/L 1.2-1.8; exterior convexity may be enormous and sometimes also present as far as br_8 (but gradually weakening); br_{3+4} diameter 1.2-1.3 mm, W/L 1.0-1.2; br_5 oblong or slightly cuneate, W/L 1.7-1.9. Following brachials cuneate, W/L 1.3-1.7, triangular by br_{10} to br_{12}, W/L 1.2-2.0 (chiefly 1.5-1.7); brachials strongly cuneate again beyond mid-arm, W/L 1.4-2.2; distal aboral margins often thin; low midaboral ridge or keel offset to longer side and/or gently curved by br_6 to br_{12}. Distal brachials with midaboral ridge ranging from virtually absent to well developed, W/L 1.6-1.7. Second syzygy variable among specimens, chiefly between br_{9+10} and br_{18+19} (extremes: br_{8+9} and br_{24+25}); distal interval chiefly five or six (mostly three or four in a few specimens, occasionally up to 11).

P_1 24-35 segments (chiefly ≥ 30), 6.4-8.4 mm; second segment with W/L 2.0-2.5. P_2 19-23 segments, 5.8-9.7 mm (chiefly > 8.0); sometimes slightly more robust than P_1; second segment as in P_1 or with weaker expansion than on first segment; distal segments with L/W up to 5.0. One arm of one specimen with P_2 similar to P_1. P_3 17-22 segments, 10-12 mm; expansion may be absent on second segment. P_4 up to 15 segments, 8.3 mm. P_2 through P_5 to P_7 increasingly wider and less tapering along most of length; tapered portion progressively more restricted to shorter distal segments. Middle pinnules 15-19 segments, 7-8 mm (chiefly 15-16, < 7.5 mm); expansion of basal segments persisting to between P_6 and P_{10}.

Disk (retained in one specimen) globular, covered with pavement of flat plates.

Color (in alcohol). — Chiefly yellowish white with pale purple bands on cirri, pinnules and, sometimes, proximal arms.

DESCRIPTION OF A SMALL PARATYPE (EcCh 33). — Centrodorsal discoidal; diameter 2.4 mm; middle of pole low rounded conical. Cirri XIII, 22-30, longest 14.4 mm; in partly double marginal row; c_{5-8} longest, L/W 1.2 (a small cirrus has c_{5-6} longest, L/W 1.3); curved aboral carina never occupying entire length of segment. On one small cirrus, curved carina present on only two cirrals before becoming crescentic spine; on another small cirrus, carinae are successively straight-profiled (on proximal cirrals), triangular, and crescentic (on distal cirrals).

Radials longer midradially than in larger specimens; lateral margins of interradial projections slightly converging; midaboral tubercle absent. Ibr_1 oblong with converging lateral margins, W/L 2.6; Ibr_2 W/L 1.4. One IIBr2 present. Arms 11; ray length 50 mm; br_1 wider exteriorly, W/L 1.6; br_2 with large exterior convexity for P_1, W/L 1.4; br_{3+4} diameter 0.9 mm, W/L 1.0, constricted at articulation; br_5 and following brachials cuneate, W/L 1.6; br_1 and br_2 with weak synarthrial swelling; br_{3+4} and following brachials with weaker midaboral ridge; br_5 and following brachials with slightly raised distal midaboral margins. Brachials triangular by br_8, W/L 1.6; weak midaboral ridge slightly curved (convex to longer side of br) but not offset, so ridge appears gently sinuous along arm; distal margin at end of ridge slightly raised. Brachials strongly cuneate by about br_{18}, W/L 1.4. Distal brachials short, cuneate, W/L 1.3; midaboral ridge as strong as on proximal portion of arm. Syzygies at br_{3+4}, br_{8+9} to br_{9+10}; distal interval three to five (chiefly four).

P_1 30 segments, 5.2 mm, second segment W/L 2.0. P_2 12 segments, 5.2 mm, slender and stiff; first segment as in larger specimens; second segment not expanded, W/L 1.3-1.5; following segments longer than wide, up to W/L 5.0 in distal half; distalmost segment short. P_3 13 segments, 6 mm. P_4 similar to P_3, 10 segments, 4.6 mm; P_5 13 segments, 5 mm. P_9 14 segments, 5.6 mm; distal six segments shorter than proximal segments but still longer than wide; maximum L/W of longest distal segments 3.7. Distal pinnules as in larger specimens; 15 segments, 6.7 mm.

Source : MNHN, Paris

ETYMOLOGY. — From the Greek *xenos* (foreign, strange) and *clados* (branch) because the IIIBr series develop interiorly rather than exteriorly as in other members of the genus.

DISTRIBUTION. — Known only from the KARUBAR collection: Kai and Tanimbar Islands, 186-205 m (possibly 184-212 m).

REMARKS. — At least three other species of *Neometra* develop brachitaxes beyond IIBr. Unlike *N. xenocladia*, their IIIBr series develop exteriorly (at least initially). *N. acanthaster* (A.H. Clark) bears up to 30 arms with exterior IIIBr2. *N. sibogae* and *N. gorgonia* bear up to about 40 arms with IIIBr2 developed exteriorly or on both IIBr branches. In *N. sibogae*, IVBr2 develop only exteriorly. In *N. gorgonia*, IVBr2 develop interiorly on the exterior IIIBr. A specimen identified as *N. spinosissima* from Phuket, Thailand (USNM E11622) (actually similar to *N. alecto* and *N. conanimis*), also bears a single exterior IIIBr2 series.

N. xenocladia shares with *N. diana* an aboral ridge on the brachials, but lacks the latter's distal triangular or spinous projections. In *N. diana*, the IBr series is similar in shape to that illustrated above for *N.* cf. *alecto*, very different from the short IBr series of *N. xenocladia* with its diverging margins.

Family THALASSOMETRIDAE A.H. Clark, 1908

REMARKS. — The family Thalassometridae is in dire need of revision. Many of the features used by A.H. CLARK (1950) to distinguish species, genera and groups of genera are either inconsistently applied or widely variable, sometimes ontogenetically. As an example, all genera but one (*Horaeometra*, with uniquely expanded genital pinnules) fall into two supposedly distinct groups: those with arms laterally compressed and carinate at least distally, and "P_1 longer and proportionally stouter than P_2, though not otherwise different" (6 genera), and those with arms aborally "rounded to the tips, never carinate; . . P_1 usually much enlarged, very stout and much broadened basally" (7 genera) (A.H. CLARK, 1950: 5-6). However, the cross-sectional shape of the distal arms in some species of *Cosmiometra* (group one) is essentially the same as in *Oceanometra* (group two). *Parametra*, which A.H. CLARK included in the first group in his key, nevertheless includes two species that bear aborally rounded arms with P_1 more or less enlarged basally (typical of group 2). CLARK (1950: 64) refered to these as transitional between the two groups, but on this basis they would be impossible to identify using his key. As a result of these difficulties, we identify several of the taxa in the KARUBAR collection only tentatively.

Genus *AGLAOMETRA* A.H. Clark, 1913

Aglaometra valida (Carpenter, 1888)

Figs 10a-c, 11e-f, 12b, 13-14; Tables 2a-b

Antedon incerta Carpenter, 1884: 57, 83, pl. 54 figs 6-7 (nomen nudum); 1888: 106, pl. 18 figs 4-5.
Antedon valida Carpenter, 1888: 104, pl. 15 figs 5-8.
Crotalometra eupedata A.H. Clark, 1909c: 404; 1912d: 209.
Crotalometra valida - A.H. CLARK, 1912c: 33, 209.
Crotalometra propinqua A.H. Clark, 1911: 549; 1912d: 209.
Crotalometra incerta - A.H. CLARK, 1912c: 33, 209.
Crotalometra vera A.H. Clark, 1912b: 427.
Crotalometra sulcata A.H. Clark, 1912b: 427.
Aglaometra valida - A.H. CLARK, 1913: 47; 1918: 163, 164, 273; 1950: 108, 109, pl. 13 figs 38-39.
Aglaometra eupedata - A.H. CLARK, 1913: 47; 1918: 163, 164; 1921: 179 fig. 225.
Aglaometra incerta - A.H. CLARK, 1913: 47; 1918: 163, 165; 1950: 108, 114.
Aglaometra vera - A.H. CLARK, 1918: 163, 165, pl. 21 fig. 54.

Source : MNHN, Paris

Aglaometra propinqua - A.H. CLARK, 1918: 163, 165; 1950: 108, 116, pl. 15 fig. 47.
Aglaometra sulcata - A.H. CLARK, 1918: 163, 164, 273, pl. 21 fig. 53; 1950: 109, 118, pl. 13 fig. 40.

MATERIAL EXAMINED. — **Indonesia**. KARUBAR, *Kai Islands*: stn CP 19: 4 specimens (MNHN-EcCh 46). — Stn 20: 1 specimen (MNHN-EcCh 45). — Stn CC 21: 15 specimens (MNHN-EcCh 43); 8 specimens (MNHN-EcCh 44).

DESCRIPTION. — Centrodorsal blunt (sometimes rounded or truncated) conical, with strong interradial projections; midradial margin moderately to deeply excavated (interradial extensions and midradial concavity reduced or absent in smaller specimens); basal diameter 3.7-7.8 mm; midradial height 2.7-6.4 mm. Aboral pole conical, rounded or flattened, smooth, spinose or tuberculate; diameter 1.4-4.3 mm. Cirrus sockets in two columns per radial area, with two to four functional sockets per column, often with one or two apical obsolete sockets. At least peripheral sockets separated midradially by flat triangular space; smaller apical sockets contiguous.

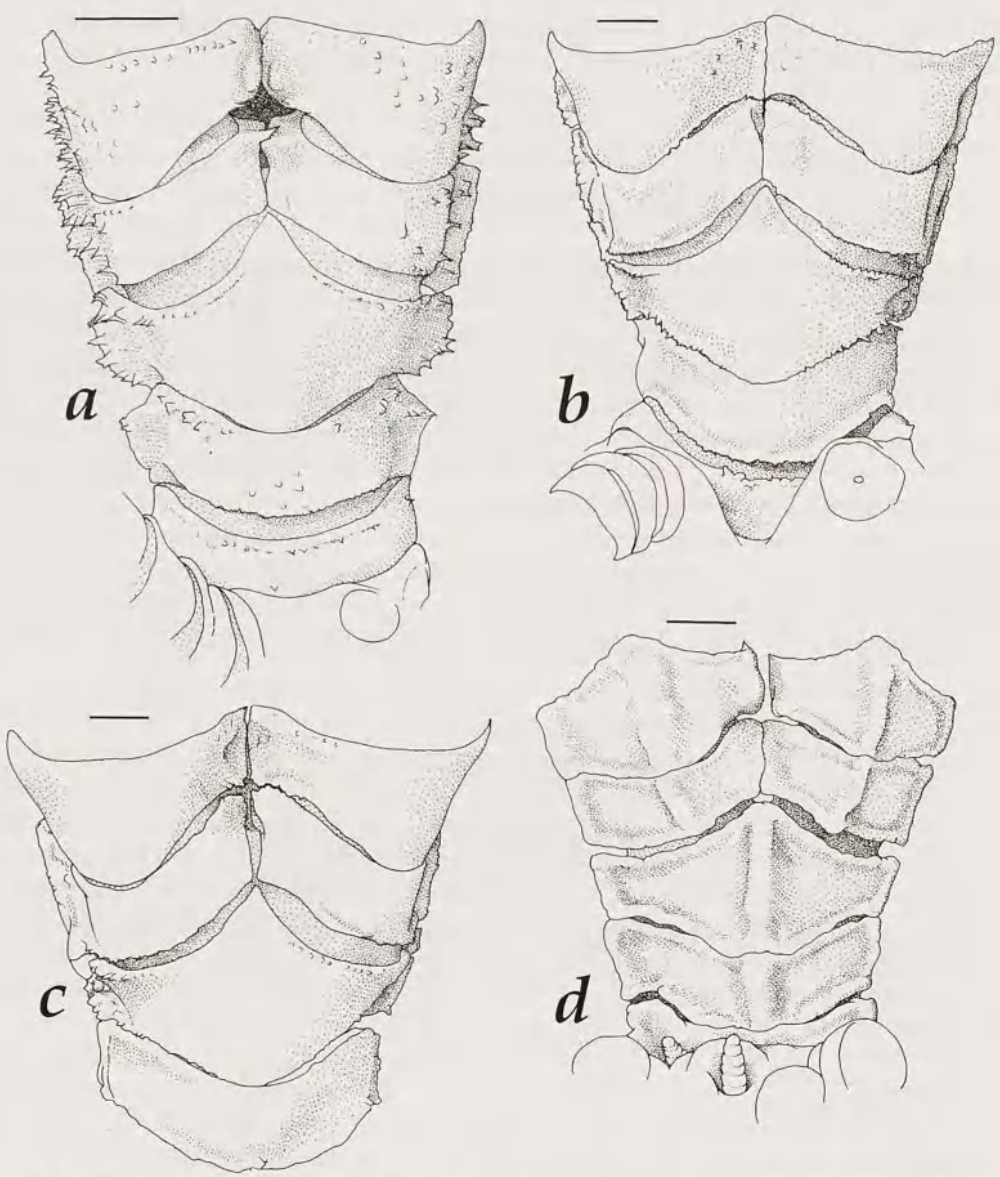

FIG. 10. — **a-c**, *Aglaometra valida* (a-b, EcCh 43; c, EcCh 46), bases of single rays (radial and centrodorsal margin omitted in c) showing variations in ornamentation; **d**, *Cosmiometra iole* (EcCh 34), base of single ray. Scale bars = 1.0 mm.

Source : MNHN, Paris

Cirri XXI-XXXVIII, 51-77, 48-75 mm long; c_1 to c_{4-7} shorter than wide; next one or two cirrals squarish (L/W ≡ 1.0); following four to seven longer than wide; c_7 or c_8 usually longest, with L/W chiefly 1.5-1.7 (rarely 1.2-2.2); following cirrals gradually shorter; distal cirrals short (L/W < 1.0); cirrus tapered near tip. Transitional cirral usually c_8 (rarely c_6-c_{10}). Small aboral spine, triangular in lateral and cross sections; first appearing between c_7 and c_{15} (chiefly c_9 to c_{12}); increasing in height and length over next several cirrals and rounded triangular in cross section; becoming taller and triangular or distally curved in distal half of cirrus; not carinate. Aboral profile of middle cirrals from proximal end of ossicle to spine tip ranges from slightly concave to straight or with low convex hump. Well-developed spines on distal half of cirrus sometimes with distal margins finely dentate and with microspines on distal face. Spines weakening and sometimes becoming rounded in lateral view on smaller segments near cirrus tip. Opposing spine tall, triangular and sharp or low and rounded, similar to preceding spines. Terminal claw gently curved, usually longer than penultimate segment.

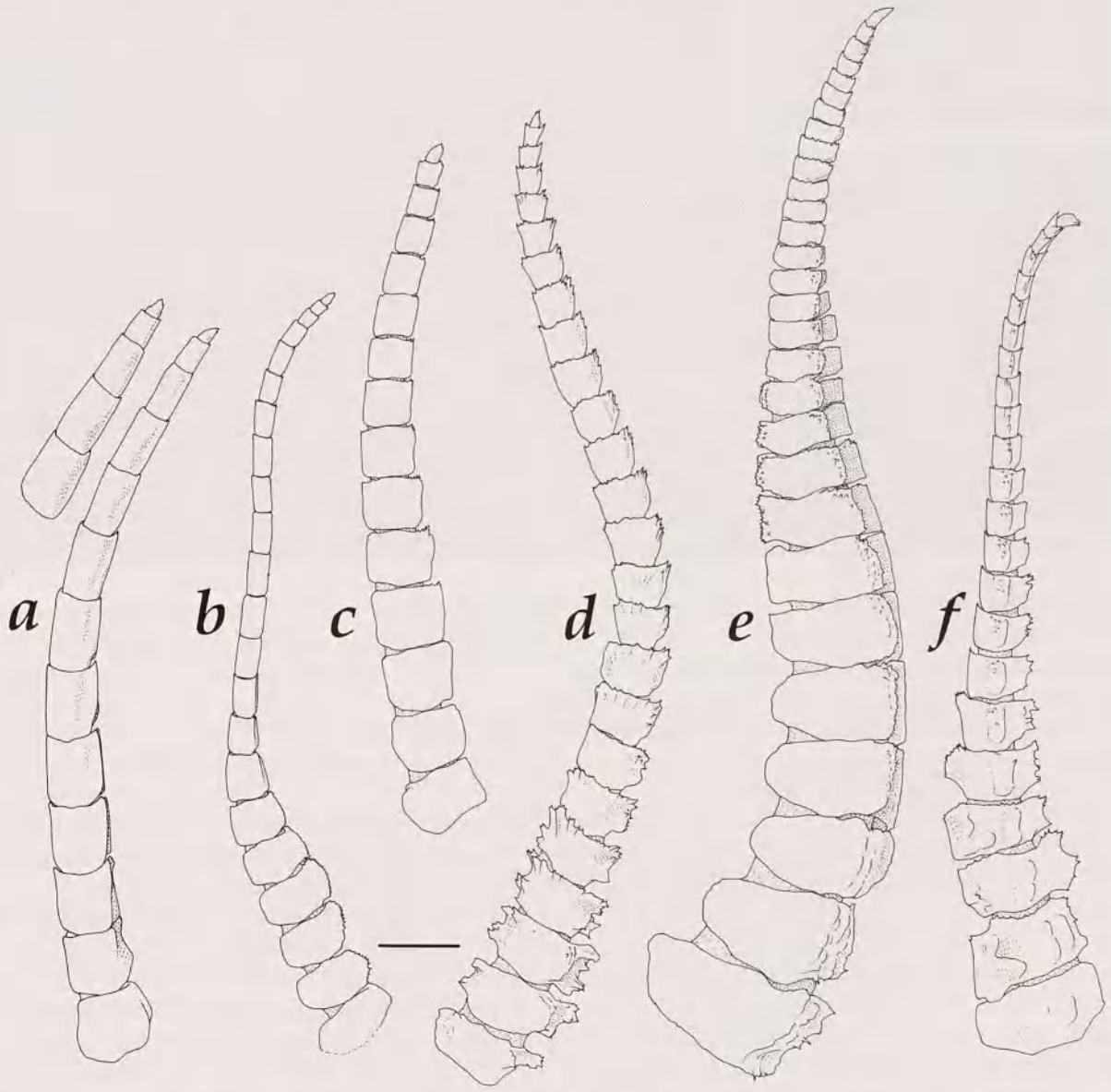

FIG. 11. — Proximal pinnules, **a**, *Stenometra cristata* (EcCh 56), P_1 (tip shown from 2 angles); **b**, *Cosmiometra philippinensis* (EcCh 37), P_1; **c**, *Cosmiometra iole* (EcCh 34), P_1; **d**, *Oceanometra annandalei* (EcCh 51), P_1; **e-f**, *Aglaometra valida* (EcCh 46): **e**, P_1; **f**, P_2. Scale bar = 1.0 mm.

Source : MNHN, Paris

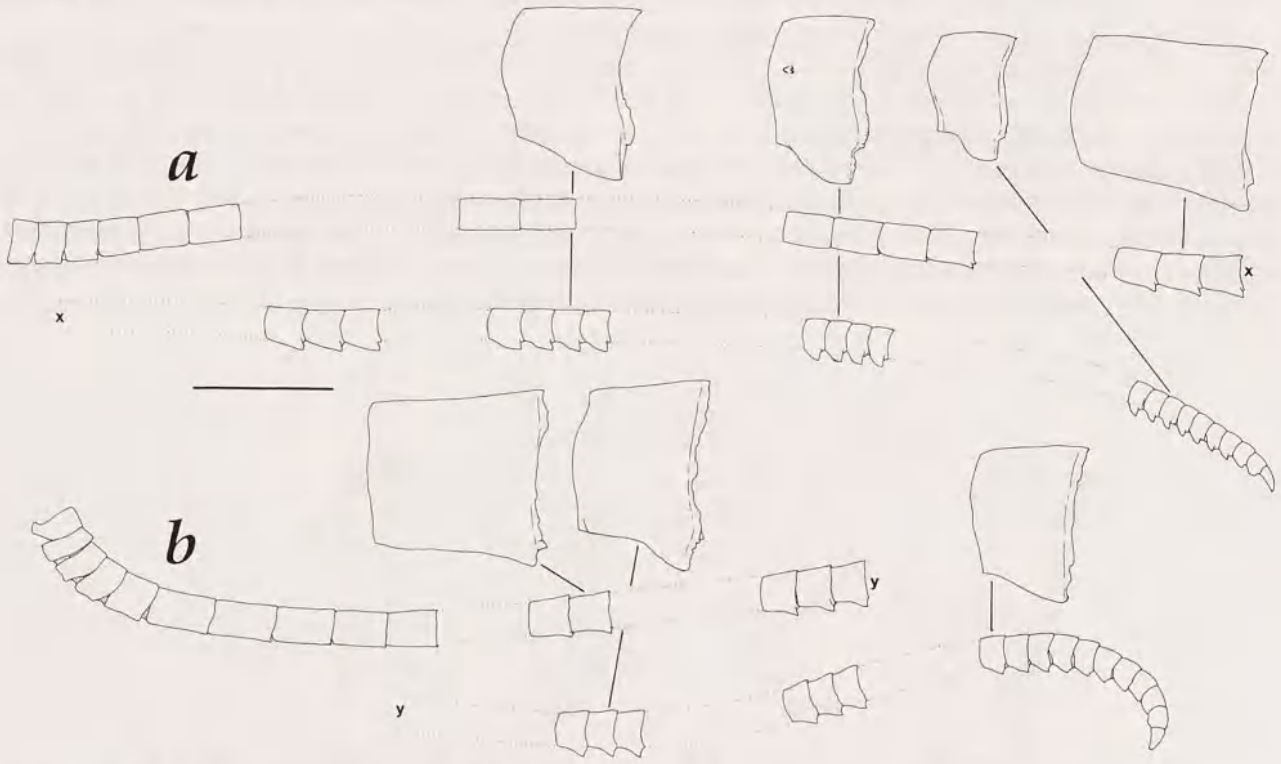

FIG. 12. — Cirri: **a**, *Oceanometra annandalei* (EcCh 48) (interrupted at x); **b**, *Aglaometra valida* (EcCh 44) (interrupted at y). Scale bar: a, b = 4.0 mm; enlarged cirrals = 1.0 mm.

Radials distally concave, usually very short, but well-exposed in some specimens; often swollen midradially to conform to excavated margin of centrodorsal (rarely with midaboral tubercle); fine spines sometimes on aboral surface or restricted to distal margin; interradial ends swollen, smooth or with 1-2 small spines.

Brachitaxes (IBr2) and first two brachials rounded to moderately arched aborally with broad, weak to moderate synarthrial swellings; lateral margins everted, flat, closely apposed and weakly rugose or spinose; no aboral carination. Ibr_1 short, shallow U-shaped, W/L chiefly 3.3-3.9 (range: 2.5-5.0); Ibr_2 axil hexagonal or pentagonal, with short slightly diverging lateral margins, W/L chiefly 1.6-1.9 (range: 1.3-2.0). Fine spines (rarely crenulae) often along proximal margin of Ibr_1 (sometimes also br_1), rarely along distal margin of axil. Fine spines, teeth or crenulae usually only along lateral thirds of distal margins (of Ibr_1 and br_1) and proximal margins (of Ibr_2 and br_2); a few tiny aboral spines rarely present.

Two smaller specimens (stn CC 21) with small "water pores" produced by truncation of distolateral corners of Ibr_1 and (interiorly) br_1, and to lesser degree proximolateral corners of Ibr_2 axil and (interiorly) br_2. One of these with numerous slender lateral spines developed on distolateral corners of ossicles from Ibr_1 to br_2 or br_4.

Arms 10; ray length 71-154 mm; br_1 short, at least shallowly U-shaped (oblong in small specimen with water pores), W/L chiefly 2.5-3.7 (range: 2.2-4.0); br_2 about twice as long as br_1, W/L chiefly 1.7-2.1 (range: 1.5-3.9); both br_1 and br_2 longer exteriorly; br_{3+4} constricted at articulation, diameter chiefly 2.7-3.3 mm (range: 2.0-3.8 mm), W/L 1.4-2.1; alternating articular tubercles weak or moderately developed (absent in some smaller specimens); br_5 to brr_{9-10} (br_{11} in one small specimen) oblong. Following brachials cuneate, usually becoming almost triangular by brr_{16-17}; brachials strongly cuneate again beyond mid-arm; weakly cuneate in distal third of arm. Aboral surface of br_4 (rarely br_2 or br_6) and following brachials with numerous small weak spines (rarely tubercles); slightly larger spines sometimes present away from midaboral line, but spines usually absent from sides of brachials; lateral ornamentation of brachitaxes rarely present as far as brr_{4-5}. Beyond proximal third of arm, aboral spines recumbent, distally directed, spread along distal margin of brachials. Beyond mid-arm, distal margins of

Source : MNHN, Paris

brachials raised, especially midaborally, with longer, stronger spines. Distal brachials compressed but not carinate, with strong midaboral spines sometimes overlapping next brachial and producing moderately serrate arm profile.

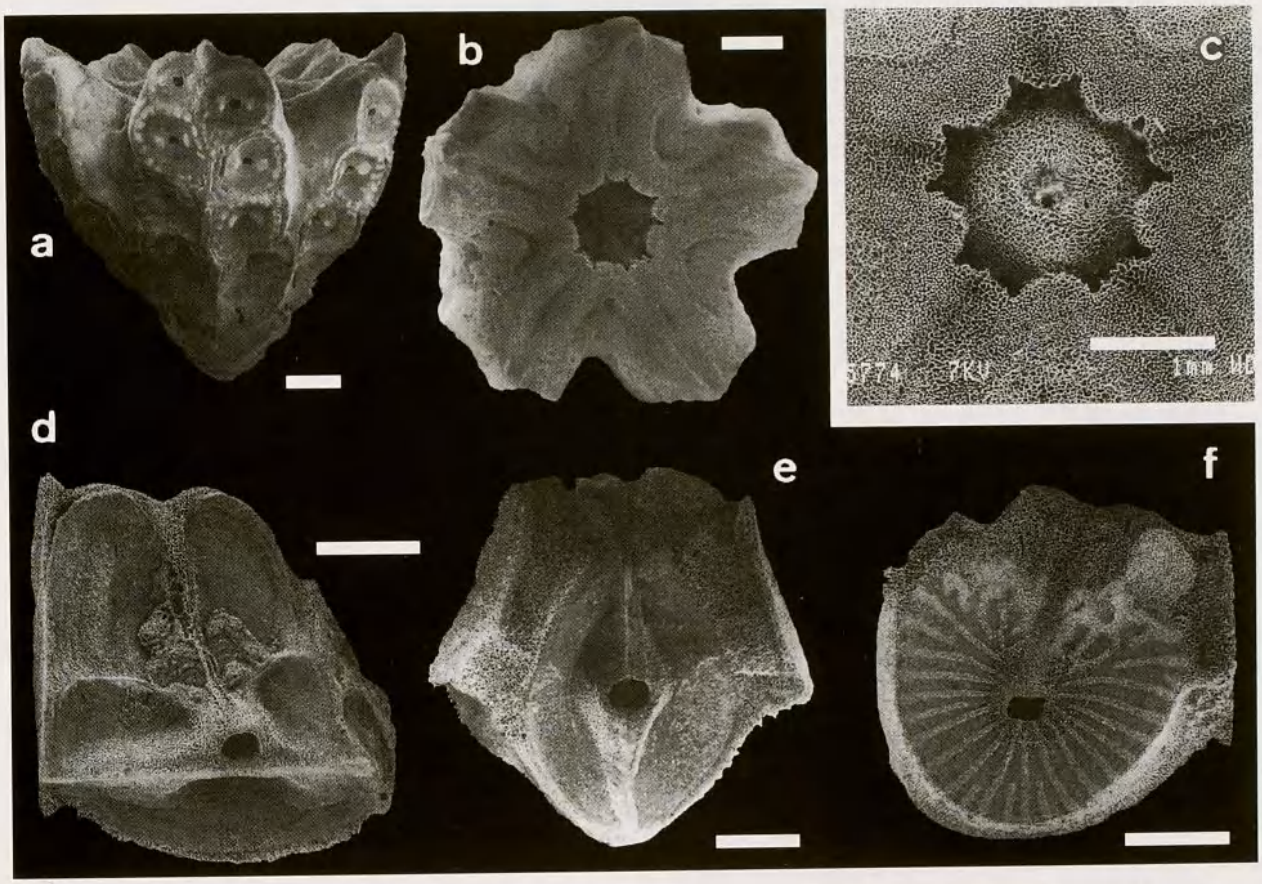

FIG. 13. — *Aglaometra valida* (EcCh 44) (SEM): **a-b**, Centrodorsal: **a**, lateral view; **b**, oral view; **c**, aboral view of radial circlet showing basal rosette; **d-f**, ray ossicles showing lateral flattening; **d**, IIbr$_1$, muscular articulation; **e**, Ibr$_2$ axil, synarthry; **f**, IIbr$_3$, syzygy. Scale bars = 1 mm.

First syzygy at br$_{3+4}$ (rarely br$_{6+7}$ to br$_{8+9}$); second usually at br$_{13+14}$ to br$_{15+16}$; distal interval chiefly five to seven, occasionally longer.

P$_1$ up to 30 short segments, 17 mm (usually 21-25, 8-12 mm), often much more robust than following pinnules; distal margins of distal segments spinose; bases of adjacent P$_1$ (and P$_a$) usually apposed and flattened. Pinnules decreasing in length and strength from P$_1$ to P$_{5-7}$; pinnules longer thereafter. Bases of proximal pinnules often rugose or finely spinose, with one or both lateral margins sometimes extended as irregularly spinose flanges (flange or spines often restricted to lateral margin facing arm tip). On middle pinnules, W/L of distal segments up to 1.4; middle pinnulars sometimes slightly broadened. Distal pinnules up to 28 segments, 19 mm; basal two segments trapezoidal and often much broader than succeeding segments; W/L of distal segments up to 1.5 (longer in small specimens). Middle and distal pinnules with abambulacral margin carinate and spinose (sometimes first appearing on distal segments of P$_{2-3}$); sometimes with middle segments slightly broadened.

Disk densely covered, at least along ambulacra and on anal papilla, by small rounded nodules (sometimes peanut-shaped or flattened); nodules usually absent from disk margin.

DESCRIPTION OF A SMALLER SPECIMEN (Stn CP 20). — Centrodorsal similar to preceding, but margin only slightly concave midradially; peripheral cirri separated only by small triangular area; basal diameter 3.7 mm;

Source : MNHN, Paris

D/H 2.7. Small obsolete apical sockets almost cover pole except for small rounded apex. Cirri XXI, 58, 48 mm; c_{1-4} short; c_5 squarish; c_{6-12} longer than broad, L/W 1.5; small proximal aboral spines more rounded in cross section than in preceding specimens, but becoming more sharply triangular on shorter middle and distal cirrals; opposing spine taller than preceding spines.

Radials well exposed with large midaboral round knob. Brachitaxis ossicles arched aborally with trace of broad aboral ridge, not flat-sided or apposed. Ibr_1 not united laterally but in contact; lateral margins sometimes slightly everted with one or two distolateral spines, and converging distally to form large water pores. Ibr_2 axil hexagonal with short diverging lateral margins; disto- and proximolateral margins weakly everted with several strong spines.

Arms 10; ray length 88 mm; br_1 almost oblong, not U-shaped; slightly longer exteriorly; slightly everted, flat-sided and apposed exteriorly with one or few interior distolateral spines; br_2 larger, longer exteriorly; interior lateral margin slightly everted with proximolateral spine; neither flattened nor apposed exteriorly. Water pores well developed interiorly, smaller exteriorly; brr_{1-3} with very weak trace of midaboral ridge; brr_{5-8} oblong. Brachials strongly cuneate, almost triangular by br_{12}, remaining almost triangular to mid-arm, less cuneate distally, strongly compressed and weakly cuneate near tip. Fine aboral spines first appear weakly on about br_{10}; very weak on proximal arm; better developed and distally directed on distal half of arm. Distal intersyzygial interval generally four or five (up to eight).

P_1 and P_a weakly flattened if at all; lateral extended margins of proximal pinnulars rounded and lacking spines. Weak spines present on distal segments of proximal pinnules. Middle and distal pinnules not expanded. Pinnulars of distal pinnules elongated.

DISTRIBUTION. — A.H. CLARK (1950) recorded *Aglaometra valida* in the narrow sense from Mindanao, Philippines, to northern Sulawesi (Celebes), Indonesia, in 457-1165 (possibly 1264) m. Inclusion of the three other species in the genus (see Remarks following) extends the range to the northern Philippines (Luzon), the Kermadec Islands and northern New Zealand (A.H. CLARK, 1950; MCKNIGHT, 1977). The KARUBAR material falls well within this range.

REMARKS. — The four species recognized by A.H. CLARK (1950) form a rough size gradient from the large, robust *valida*, followed in descending order by *incerta*, *propinqua* and *sulcata*. Most KARUBAR specimens are equivalent to *propinqua*, but the material spans much of the genus' known variability and a few specimens closely approach the other three species. As a result, the four are herein synonymized. Only cirrus length previously recorded for *A. valida* exceeds that of the KARUBAR material. Previously recorded specimens of all four species bear fewer cirri (X-XX) than the KARUBAR material (XXI-XXXVIII), but this simply reflects a difference of one or two versus two to four cirri per column. Many KARUBAR specimens also bear one to several tiny immature peripheral cirri that may not have been included in earlier descriptions.

One feature used by A.H. CLARK to distinguish *A. valida* from *A. incerta* — variations in the angle of the profile of the proximal part of the rays — is most likely a vagary of preservation. The water pores diagnostic of *A. sulcata* appear on two smaller KARUBAR specimens that are otherwise indistinguishable from the rest or from the yet smaller specimen described separately above. The expansion of the basal two pinnulars of the distal pinnules that CARPENTER (1888) used to distinguishing *valida* from *incerta* also varies.

Although CARPENTER first mentioned *Antedon incerta* in 1884, the species cannot be identified from his diagnostic specific formula (which applies equally to several ten-armed thalassometrids) or his comments about its pinnules. CARPENTER described both *Antedon incerta* and *Antedon valida* in 1888 with the latter having page precedence. When A.H. CLARK first mentioned *Aglaometra* (1913), he included *valida* and *incerta* but neither diagnosed the genus nor indicated a type species. A.H. CLARK finally designated *valida* as the type species of *Aglaometra* in 1950.

ON VARIATIONS. — A close examination of variability in skeletal characteristics of *Aglaometra valida* reveals several important features critical to their diagnostic and descriptive value.

1) Different body parts exhibit different levels of variability (Tables 2a-b). Most cirrus characteristics exhibit narrower coefficients of variation (V) [8.4% (position of longest cirral) to 15.0% (number of cirri/column)] than do centrodorsal traits [18.5% (basal diameter) to 27.1% (diameter of pole)] or proximal ray ossicle dimensions [9.7%

Source : MNHN, Paris

(Ibr2 width) to 22.6% (Ibr1 length)]. Features of major body parts thus vary somewhat independently. Each specimen must be interpreted as a mosaic of somewhat independent traits.

Sp.	Sta.	Centrodorsal					Cirri								Longest cirral				P_1	
		Diameter		Height	D/H	S	No.	Max.	No.	Trn.	1st	Cirri/	No.	U	Seg.	L	W	L/W	L	No.
		Pole	Base				Cirri	L	Segs.	Seg.	Spin.	Col.	Reg.		No.					Segs.
1	21	3.2	5.4	3.8	1.4	32.3	30			8	14	3	3	0.9	8	**1.2**	**0.7**	1.7	8.3	21
2	21	3.0	6.4	4.3	1.5	42.8	32	64	63	8	10	3	2	0.7	8	***2.2***	1.1	***2.0***	9.4	23
3	21	2.9	5.4	4.9	1.1	41.7	27	57	60	8	10	3	**0**	0.6	8	1.5	1.0	1.5	9.5	25
4	21	3.0	5.6	4.2	1.3	36.7	29	49	**51**	8	11	3	12	0.8	8	1.5	1.1	**1.3**	***17.0***	16
5	21	2.5	6.7	5.4	1.2	56.5	29			8	9	3	8	0.5	8	1.5	1.1	1.3		
6	21	2.2	4.6	4.1	1.1	29.8	33	56	54	8	10	3	5	1.1	8	1.7	1.1	1.6	8.9	25
7	21	2.5	4.6	4.1	1.1	29.8	32	62	57	7	9	3	4	1.1	7	2	1.2	1.6		
8	21	2.5	5.7	3.0	1.9	27.1	27	56	64	8	12	3	6	1	8	1.7	1.1	1.6		
9	21	2.2	6.4	3.7	1.7	37.2	35	67	68	8	11	4	7	0.9	8	1.5	1.1	**1.3**		
10	21	3.0	4.0	3.8	**1.0**	23.7	26	56	52	7	9	3	7	1.1	7	1.9	1.0	1.9		
11	21	2.4	6.5	3.7	1.8	37.3	27	55	52	8	10	3	6	0.7		1.9	1.2	1.5		
12	21	2.2	5.4	3.3	1.6	28.2	29	54	57	7	10	3	***12***	1	7	1.7	1.1	1.6		
13	21	2.7	6.8	5.7	1.2	61.2	37	55	59	8	10	4	5	0.6	8	1.7	1.1	1.6	11.1	***30***
14	21	***4.3***	***7.8***	4.0	2.0	48.5	37			8	11	4	9	0.8	8	1.9	1.2	1.5		
15	21	1.7	4.4	3.0	1.5	21.1	31	54	58	7	9	3	10	1.5	7	1.7	1.0	1.7		
A	19	4.0	6.4	6.0	1.1	59.8	33	55	60	8	9	3	5	0.6	8	1.9	1.2	1.6	12.7	29
B	19	3.6	6.7	2.8	***2.4***	29.0	32	58	58	***10***	***15***	3	2	1.1	9	1.7	1.1	1.5		
C	19	3.9	6.8	***6.4***	1.1	***68.6***	30	54	66	9	10	4	1	**0.4**	7		1.1		9.4	25
D	19	3.2	6.3	5.6	1.1	55.4	29	66	***77***	8	12	4	3	0.5		1.7	***1.4***	**1.3**	11.1	24
E	21	2.4	5.6	4.4	1.3	38.8	***38***	60	65	8	11	4	8	1	8	1.9	1.2	1.5	8.0	23
F	21	2.1	4.4	3.2	1.4	22.1	31					3	6	1.4					6.9	21
G	21	1.9	5.2	4.0	1.3	32.7	33	53	57	8	11	3	6	1	8	1.7	1.2	1.4	9.0	24
H	21	1.6	3.8	**2.7**	1.4	16.2	25			**6**	**7**	3	5	***1.5***	**6**	1.5	1.0	1.5		
I	21	4.0	7.1	5.4	1.3	60.5	31	***75***	72	9	***15***	3	5	0.5	***9***	1.9	1.4	1.4	11.8	26
J	21	3.0	5.7	4.4	1.3	39.8	34	59	60	8	11	3	9	0.9	8	1.7	1.2	1.4	8.5	21
K	21	2.7	5.9	4.1	1.4	38.1	27	61	61	8	12	3	1	0.7	8	1.6	1.0	1.6		
L	21	2.7	5.9	4.3	1.4	39.5	32	56	58	8	11	3	6	0.8	8	1.7	1.2	1.4	**5.0**	**15**
M	20	**1.4**	**3.7**	2.7	1.4	**15.7**	**21**	**48**	58	7	8	2	4	1.3		1.5	1.0	1.5	7.1	16
n		28	28	28	28	28	28	23	23	27	27	28	28	28	24	26	27	27	11	11
$\bar{X}$		2.7	5.7	4.2	1.4	38.2	30.6	57.6	60.3	7.9	10.6	3.2	5.6	0.9	7.8	1.7	1.1	1.5	9.2	23
Mode							32	56	58	8	10	3	5		8	1.7	1.1	1.6		
s		0.7	1.1	1.0	0.3	14.2	3.9	5.9	6.3	0.8	1.9	0.5	3.1	0.3	0.7	0.2	0.1	0.2	2.36	4.7
V (%)		27.1	18.5	24.3	22.6	37.2	12.6	10.3	10.5	9.5	17.7	15.0	55.4	33.4	8.4	11.9	11.9	10.9	25.7	20.4

TABLE 2a. — *Aglaometra valida*; measurements and statistics for 19 traits: centrodorsal, cirri and P_1 (n = 28). Abbreviations: *Sp.*, specimen number; *Sta.*, station number; *D/H*, ratio of basal diameter to midradial height; *S*, centrodorsal surface area [π x (basal diam./2) x midradial height]; *No. Cirri*, number of cirri; *Max. L*, maximum length of longest cirrus; *No. Segs.*, number of segments of longest cirrus; *Trn. Seg.*, transition segment, counting from cirrus base; *1st Spin.*, most proximal cirral with an aboral spine/tubercle; *Cirri/Col.*, number of cirri per column on centrodorsal; *No. Reg.*, number of regenerating cirri; *U*, ratio of number of cirri to centrodorsal surface area; *Seg. No.*, longest cirrus segment counting from cirrus base; $\bar{X}$, mean; *s*, standard deviation; *V*, coefficient of variation expressed as a percentage. All length (L) and width (W) measurements are in millimeters (mm). Minimum values are in expressed as a percentage. All length (L) and width (W) measurements are in millimeters (mm). Minimum values are in boldface and maximum values in italic boldface except where more than four specimens exhibit equivalent values.

As an example, centrodorsal surface [taken as the surface of a cone expressed as S = π x (basal diameter / 2) x midradial height] varies from 15.7 to 68.6 mm^2 with V = 37.2%. If cirri increase in numbers correspondingly, their number per unit surface area (U = number of cirri / S) should remain relatively constant. However, U varies from 0.44 to 1.55 cirri mm^{-2}. Number of cirri is thus not correlated with centrodorsal surface area. The cirri are concentrated on the proximal two-thirds of the centrodorsal, leaving a naked apex (recorded as pole diameter in Table 2a). The total surface may thus be divided into an area occupied by cirri that remain relatively uniformly spaced, and a variable naked aboral pole. A bivariate analysis (not shown here) in which polar diameter correlates

Source : MNHN, Paris

inversely (r = 0.70) with cirri per unit area (U) confirms this. Centrodorsal size thus varies independently of the number of cirri (except for the smallest specimens). Variation in aboral pole dimensions account for differences between small and larger centrodorsals.

Sp.	Sta.	Rays															
		Ray	Ibr_1			Ibr_2			br_1			br_2			br_{3+4}		
		L	L	W	W/L	L	W	W/L	L	W	W/L	L	W	W/L	L	W	W/L
1	21		1.5	3.7	**2.5**	2.4	4.8	***2.0***	1.0	3.0	3.0	1.6	3.5	2.2	1.7	2.8	1.6
2	21		1.0	4.4	4.5	3.1	5.2	1.7	1.1	3.7	3.3	1.7	***4.0***	2.3	***2.2***	3.1	**1.4**
3	21		1.1	3.1	2.8	2.7	4.3	1.6	1.1	3.1	2.8	1.9	3.2	1.7	1.7	3.0	1.7
4	21		1.0	3.8	3.9	2.7	4.4	1.6	1.1	3.2	2.9	1.7	3.7	2.1	2.0	3.1	1.6
5	21		1.2	4.1	3.3	2.7	4.4	1.6	1.1	3.2	2.9	1.9	3.3	1.8	1.9	2.7	1.5
6	21		1.1	3.7	3.3	2.5	4.4	1.8	1.1	3.1	2.8	1.9	2.8	**1.5**	1.9	2.7	1.5
7	21		1.1	3.8	3.5	2.6	4.3	1.7	1.2	3.1	2.5	1.7	3.5	2.0	1.7	3.3	1.9
8	21		0.6	3.1	***5.0***	2.4	3.7	1.6	0.9	3.1	3.6	1.5	3.2	2.2	1.5	2.8	1.9
9	21		1.1	4.3	3.9	2.6	4.3	1.7	1.1	3.3	3.0	1.7	3.6	2.1	1.7	3.3	1.9
10	21		0.7	3.6	4.8	2.4	4.2	1.8	1.1	3.5	3.1	1.5	3.1	2.1	1.9	2.7	1.5
11	21		1.0	3.7	3.7	2.7	4.4	1.6	1.0	3.6	3.6	1.7	3.3	1.9	1.7	3.2	1.9
12	21		0.9	3.5	4.0	2.4	4.0	1.7	1.0	2.8	2.8	1.5	3.1	2.1	1.6	3.2	2.0
13	21		1.1	4.3	3.9	2.5	4.6	1.9	1.2	3.3	2.7	1.9	3.3	1.8	2.0	2.8	**1.4**
14	21		1.5	4.7	3.2	3.1	***5.6***	1.8	***1.4***	***4.2***	3.1	***2.1***	***4.0***	1.9	2.0	3.6	1.8
15	21		0.9	2.7	3.2	2.5	3.3	**1.3**	0.7	2.7	3.7	1.6	3.0	1.9	1.7	2.5	**1.4**
A	19	***154***	1.0	4.3	4.5	3.0	5.1	1.7	1.1	3.5	3.1	1.9	3.5	1.8	***2.2***	3.2	**1.4**
B	19		***1.6***	***6.4***	4.0	***4.3***	***5.6***	**1.3**	1.1	4.0	3.6	2.1	3.3	1.6	***2.2***	3.3	1.5
C	19	115	1.1	4.0	3.5	2.6	4.3	1.7	1.0	3.8	***4.0***	1.7	3.5	2.1	1.8	3.1	1.7
D	19	119	1.1	4.2	3.8	2.6	4.9	1.9	0.9	3.3	3.9	***2.1***	3.8	1.8	1.9	***3.8***	***2.1***
E	21		1.1	4.0	3.6	2.6	4.4	1.7	1.2	3.3	2.7	1.7	3.6	2.1	1.9	3.3	1.8
F	21	**71**	0.9	3.0	3.4	2.1	3.8	1.8	1.0	2.4	2.4	1.5	2.8	1.9	1.6	2.5	1.5
G	21		0.9	3.7	4.3	2.6	4.3	1.7	1.1	3.0	2.7	1.7	2.7	1.6	1.9	3.0	1.6
H	21	81	**0.7**	2.6	3.5	**2.0**	**3.1**	1.6	**0.6**	2.2	3.6	1.2	2.5	2.0	1.4	2.1	1.5
I	21		1.5	4.4	3.0	2.8	5.1	1.8	***1.4***	3.5	2.5	1.9	3.2	1.7	2.0	3.3	1.7
J	21		1.2	3.8	3.1	2.5	4.8	1.9	1.1	3.1	2.8	2.0	3.7	1.9	1.9	3.2	1.7
K	21		1.1	3.8	3.5	2.5	4.2	1.7	0.9	3.2	3.7	**0.9**	3.3	***3.9***	1.5		
L	21	98	1.1	4.0	3.6	2.5	4.7	1.9	0.9	3.2	3.7	1.9	3.7	2.0	1.6	3.1	1.9
M	20	88	0.8	**2.5**	3.3	2.1	**3.1**	1.5	0.9	**1.9**	**2.2**	1.3	**2.3**	1.7	**1.3**	**2.0**	1.5
n		7	28	28	28	28	28	28	28	28	28	28	28	28	28	27	27
$\bar{X}$		104	1.1	3.8	3.7	2.6	4.4	1.7	1.0	3.2	3.1	1.7	3.3	2.0	1.8	3.0	1.7
Mode			1.1		3.5			1.6			2.8			1.7			1.5
s		28.2	0.2	0.8	0.6	0.4	0.6	0.2	0.2	0.5	0.5	0.3	0.4	0.4	0.2	0.4	0.2
V (%)		27.1	22.6	19.8	16.1	16.3	14.2	9.7	16.6	15.5	15.9	16.0	12.5	20.9	12.9	13.8	12.3

TABLE 2b. — *Aglaometra valida*; measurements and statistics for 16 traits: rays (n = 28). *L/W*, length to width ratio; *W/L*, width to length ratio. Other abbreviations as in Table 2a.

2) With a few exceptions (e.g., smaller specimens may have water pores and a less excavated centrodorsal margin), shape does not correlate closely with size. It seems reasonable to assume, at this stage, that smaller specimens represent younger individuals. The KARUBAR specimens span a substantial size range that likely reflects age heterogeneity (at least for the smaller specimen described above). However, most descriptive traits (Tables 2a-b) reveal no distinct pattern of shape change with increasing size. For example, figure 14a illustrates the lack of any such pattern in centrodorsal shape plotted as basal diameter versus midradial height. Also, *A. valida* bears only ten arms, a possibly plesiomorphic or paedomorphic trait acquired at a young stage, and the number of cirri varies little relative to increasing size (see above). *A. valida* thus appears to develop rapidly to a point beyond which size continues to increase considerably while shape is conserved.

3) Serial components of a body part may also exhibit different levels of variability both between and within components. For example, Ibr_1 varies much more in width than do the following ossicles (Fig. 14b, top). Regeneration cannot account for the variation because rays autotomize and regenerate at syzygies, which do not

Source : MNHN, Paris

appear in *A. valida* proximal to br_{3+4}. By contrast, Ibr_1 and br_1 vary much less in length than does Ibr_2 (Fig. 14b, bottom). The distal articulation in the former two is a synarthry, suggesting that variability may be constrained by both structure and function.

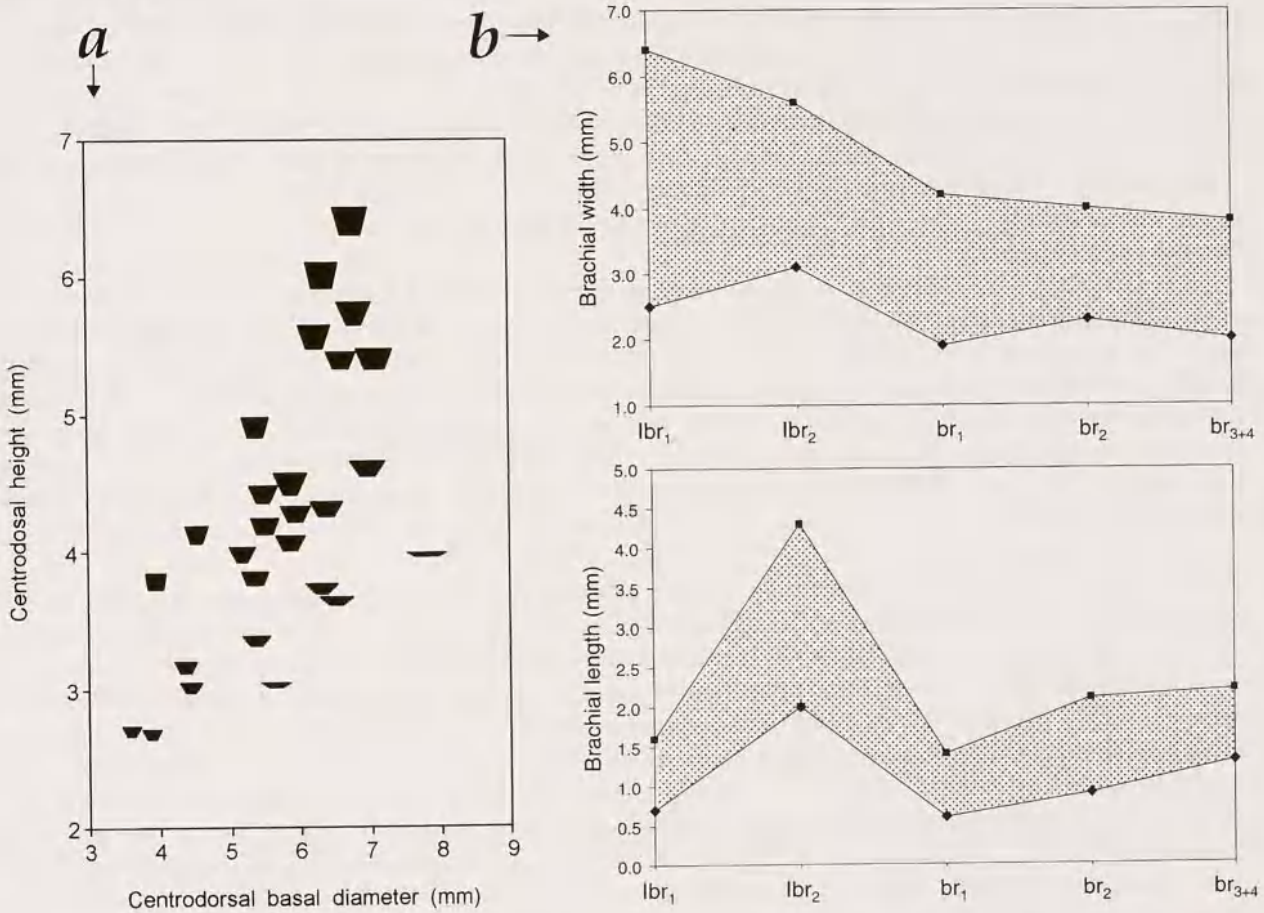

FIG. 14. — *Aglaometra valida*: **a**, Plot of basal diameter versus midradial height of centrodorsal. Individual data points show centrodorsal shape (derived from height, basal diameter and apical diameter measurements). **b**, Maximum (squares) and minimum (diamonds) widths (top) and lengths (bottom) of proximal ray ossicles (Ibr_1, Ibr_2, br_1, br_2, br_{3+4}) (n = 28).

Genus ***COSMIOMETRA*** A.H. Clark, 1909

Cosmiometra iole A.H. Clark, 1950

Figs 10d, 11c, 15a

Cosmiometra iole A.H. Clark, 1950: 43, 61, pl. 4 fig. 14.

MATERIAL EXAMINED. — **Indonesia**. KARUBAR: *Tanimbar Islands*: stn CP 86: 4 specimens (MNHN-EcCh 34).

DESCRIPTION. — Centrodorsal low hemispheric; diameter 5.0-6.4 mm; D/H 2.2-2.8; periphery slightly concave radially or not excavated at all; small protruding interradial process sometimes developed as short narrow, projecting ridge. Aboral pole irregularly convex, with several low tubercles or irregularly eroded. Cirrus sockets crowded three across each radial area, 1-2 high, not organized in distinct columns.

Source : MNHN, Paris

Cirri XXVI-XXXV, 30-47, 27-36 mm; short relative to arm length for a thalassometrid; c_{1-3} or c_4 short; c_4 or c_5 slightly longer, L/W 0.7; c_5 or c_6 longest, slightly constricted, transitional, L/W 1.8-2.0; following cirrals compressed but not carinate, gradually shorter; c_{11} or c_{13} with L/W 1.0; c_1 sometimes with a distinct aboral knob. Slightly subdistal aboral transverse ridge (weakly dentate, convex in cross section) first appearing on c_5 or c_6, increasing in size on following cirrals, initially triangular in profile, becoming a crescentic, compressed, strongly hooked spine on shorter distal cirrals. Alternatively, the transverse ridge strongly rounded in profile (triangular in profile on a few cirrals if at all); becoming a tall, erect or distally tilted, compressed, tab- or tongue-like process on distal cirrals; rarely hooked and sharp; sometimes eroded, especially near cirrus tip. Opposing spine a distally tilted triangle, no larger than preceding spines. Terminal claw gently curved, as long as or longer than penultimate cirral.

Radials barely visible midradially, if at all; smooth, with one or two round tubercles or an irregular distal margin; corners rising to tall round tubercles; tubercles of adjacent radials meet distal to short interradial projections of centrodorsal.

All brachitaxes (I and IIBr) of two ossicles each; moderately arched, flat-sided and laterally apposed, with rounded synarthrial swellings and smooth, low midaboral ridges. Ossicle margins weakly to moderately everted, at least in lateral portions (never midaborally); eversion smooth, irregular, or with weak rounded teeth, strongest on Ibr_1 and proximolateral margins of Ibr_2 axil, weaker distally but detectable on br_1 in one specimen. Ossicles joined by synarthry have lateral margins projecting laterally well beyond synarthrial ligaments, leaving a small water pore interiorly between adjacent $IIbr_1$ and $IIbr_2$, and between adjacent br_1 and br_2. IBr2 series with gently diverging lateral margins; Ibr_1 short, shallowly concave distally, W/L 3.3-4.0; Ibr_2 hexagonal, W/L 1.8-2.0. $IIbr_1$ slightly longer exteriorly, W/L 3.0; $IIbr_2$ hexagonal with straight lateral margins, W/L 1.4-1.5. One interior IIIBr2 series present in one specimen.

Arms 20-21; ray length 110-120 mm. Proximal brachials flat-sided to between br_{12} and br_{20}; brachials in proximal third of arm very tall (along ambulacral-abambulacral axis); low, narrow, midaboral ridge of brachitaxes continued on all brachials. Middle and distal brachials moderately compressed so that they appear carinate; distal margins finely spinose by about br_{20}, raised and sometimes with stronger spines, especially midaborally, producing weakly serrate profile on middle and distal arms; distally projecting midaboral ridge spines sometimes overlapping base of next brachial; br_1 slightly longer exteriorly, with interior lateral margin weakly everted, W/L 2.2; br_2 larger, W/L 1.3; br_{3+4} squarish, 1.7-2.0 mm across, W/L 1.2; br_5 to brr_{8-10} slightly cuneate, W/L 1.7-2.5. Next two or three brachials almost oblong (clearly less cuneate), sometimes slightly shorter than preceding brachials (very short in side view; almost four times taller along ambulacral/abambulacral axis than long), W/L 1.9-2.2. Following brachials becoming almost triangular by about br_{18}, W/L 1.8-2.1. Brachials cuneate again beyond mid-arm, W/L 1.5; distal brachials short, cuneate, W/L 1.6-1.8. Syzygies at br_{3+4}; next at br_{13+14} to br_{24+25}; next interval seven to 13; distal interval mostly five or six (up to nine) articulations.

Proximal pinnules robust, of short stout segments. P_1 of 15-19 segments, 9-12 mm; proximal 4-5 segments flat, smooth, sometimes broadened and laterally carinate (side facing arm tip); following pinnulars smooth except that carinate abambulacral lateral margin may rise to distal rounded triangular process or spine. P_2 similar to smaller P_1, 14 segments, 8.5 mm; or much smaller and narrower, 13 segments, 7.6 mm. P_3 similar to P_2 or smaller, 10 segments, 5.2 mm. Following pinnules gradually shorter and weaker to about P_{7-8}; P_6 10-11 segments, 5.0-5.6 mm; P_8 9 segments, 4.4 mm. Following pinnules gradually longer; middle pinnules 14-15 segments, 7-8 mm; distal pinnules 17 segments, 9 mm.

Disk naked.

Color (in alcohol). — White; or proximal arms brown laterally; middle and distal syzygies and sometimes one or two adjacent brr brown or tan; proximal pinnules banded brown and white.

DISTRIBUTION. — Known only from Zamboanga in the southern Philippines (A.H. CLARK, 1950) and Tanimbar Islands in Indonesia, in 225-292 m (possibly 223-365 m).

REMARKS. — The KARUBAR material represents the only known specimens of this species apart from the two collected by MORTENSEN's Pacific Expedition in the Philippines in 1914 and described by A.H. CLARK in 1950. The specimens depart from the original description only as a result of their larger size. The description of the type

Source : MNHN, Paris

specimen, for example, cites XVII cirri, 25 mm long, of 29-35 segments, and P_1 7 mm long, of 14 segments of which the distal are longer than broad.

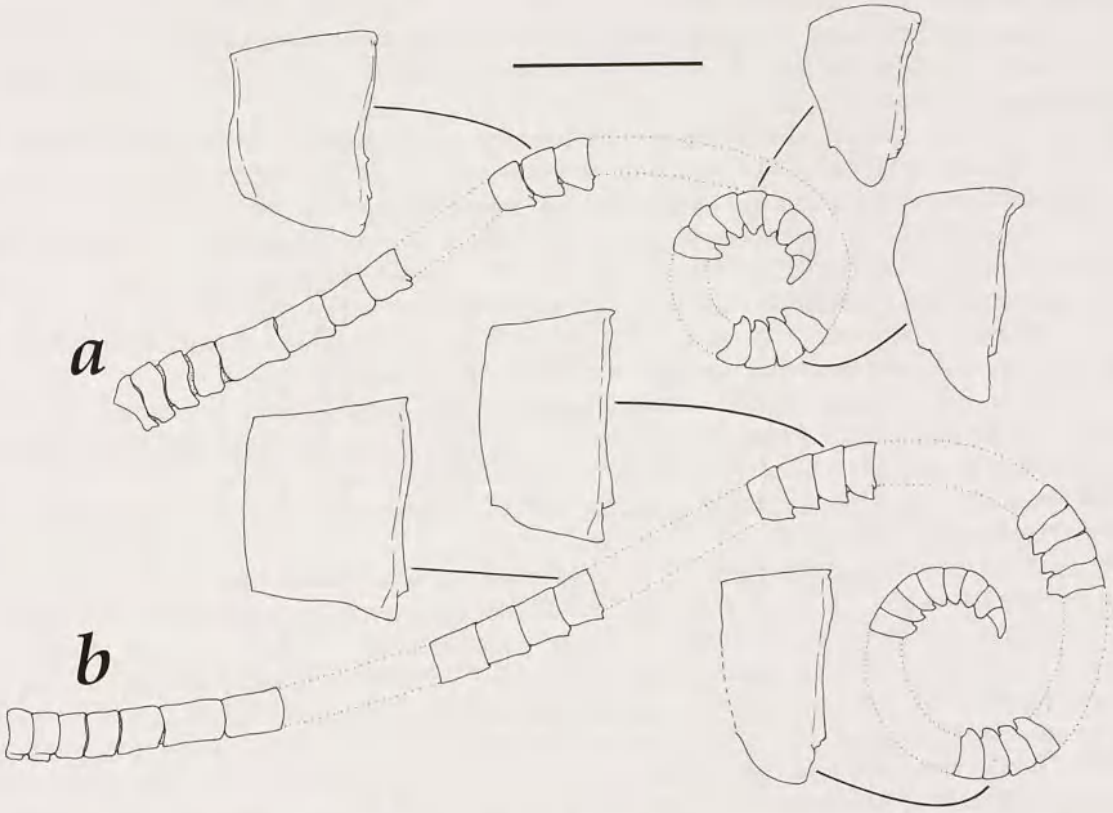

FIG. 15. — Cirri: **a**, *Cosmiometra iole* (EcCh 34); **b**, *Cosmiometra philippinensis* (EcCh 37). Scale bar: a, b = 4.0 mm; enlarged cirrals = 1.0 mm.

Cosmiometra philippinensis A.H. Clark, 1911

Figs 11b, 15b; Table 3

Cosmiometra philippinensis A.H. Clark, 1911: 548; 1912c: 215; 1918: 153, 155, 272, 274, pl. 23 fig. 61; 1950: 43, 52, pl. 5 fig. 16, pl. 6 fig. 22.

MATERIAL EXAMINED. — **Indonesia**. KARUBAR: *Kai Islands*: stn CP 05: 3 specimens (MNHN-EcCh 38). — Stn CP 16: 16 specimens (MNHN-EcCh 37). — Stn CP 27: 1 small specimen (MNHN-EcCh 35).

DESCRIPTION. — Centrodorsal conical or truncated, rounded or blunt conical; covered with papillae, at least basally; margin with shallow, usually V-shaped, midradial excavation; basal diameter 3.5-6.0 mm; midradial height 1.5-4.0 mm; D/H 1.3-1.9. Aboral pole conical or rounded, smooth or papillose. Cirri in ten columns of 2-4 sockets per column; adjacent columns very closely crowded, with sockets alternating interradially; columns separated midradially by triangular papillose space; apical sockets still separated midradially.

Cirri XX-XXIX, 53-65, maximum length 37-45 mm. Cirri compressed beyond basal few cirrals, tapered near tip; c_1 to c_{4-6} short; c_{4-6} still shorter than long or squarish; next two or three cirrals longest, abruptly longer than preceding, L/W 1.1-1.8; following cirrals gradually shorter, squarish by c_{10-12}; c_{5-7} transitional (the more proximal cirrals usually brown; the more distal cirrals white); c_{10-13} and following cirrals becoming aborally carinate with slightly subdistal aboral triangular spine. Spines triangular in cross section, enlarging and lengthening on

Source : MNHN, Paris

succeeding cirrals, with erect distal margin often bearing one or few teeth; spines becoming curved and crescentic on shorter distal cirrals (proximal profile strongly convex, distal profile often slightly concave), smaller and narrower (no longer with triangular transverse face) on distal few cirrals, still curved and sharp or sometimes weak and rounded; length of spine base shorter than cirral length. Opposing spine blunt or triangular, distally directed, much larger than preceding spines. Terminal claw gently curved, longer than penultimate cirral.

Radials hidden or visible as extremely narrow band or small midradial triangle, concave distally, covered with fine, often spinulose, spines.

Brachitaxes all of two ossicles (I-IIIBr), gently to moderately convex aborally; lateral margins straight, flat and apposed; Ibr_1 shallow V-shaped, W/L 3.0-4.1; lateral portions thickened and flared, rugose, or with spinulose spines or papillae, often appearing spongy; ornamented area broadest proximally, continuous across flared proximal margin, but restricted to lateral quarters or thirds of aboral surface; Ibr_2 axil hexagonal, short and wide, W/L 2.0-2.1. Raised spongy ornamentation occupying progressively narrower lateral portion of successive ossicles, disappearing beyond $IIIbr_2$ axil. IIBr similar to IBr; $IIbr_1$ still thickened with rugose ornament exteriorly; smooth and flat except for few small distolateral spines interiorly, W/L 3.1-3.7; $IIbr_2$ axil with spinulose thickening stronger exteriorly, but sometimes reduced to narrow band of fine spinules, W/L 1.4-1.6.

One specimen differs in having the proximal margin of Ibr_1 slightly raised midaborally, if at all; one IIBr4(3+4), and the IIBr series slightly flattened exteriorly, if at all. Another specimen has brachitaxes with low synarthrial swellings and Ibr_1 with a weak midaboral ridge; ornament similar to that of preceding specimens, somewhat weaker than most, but with entire aboral surface of brachitaxes and arm base ossicles bearing scattered tiny spines (fewest midaborally).

Arms 18-20 (chiefly 20); ray length 65-105 mm. Proximal brachials more strongly convex than brachitaxes ossicles; laterally flat to brr_{4-5}. Ornament similar to that of brachitaxes (ossicles weakly thickened and spinulose laterally) present at most to br_3 exteriorly and br_5 interiorly, usually strongest at interior-distal corner of br_1 and interiorly on br_2; br_1 almost oblong, concave distally, W/L 2.1-2.2; br_2 larger, longer exteriorly, proximal margin moderately convex, W/L 1.5-2.0; br_{3+4} diameter 1.5-1.8 mm, W/L 1.2-1.3; br_5 to brr_{9-10} short, oblong, with slightly concave lateral margins, W/L 1.7-2.0. Following brachials becoming cuneate (never triangular), W/L 2.3 at mid-arm. Distal brachials strongly compressed but never carinate, weakly cuneate, with longer side expanded for pinnule base, W/L 1.0-2.0. Aboral surfaces of brachials beyond proximal fourth or third of arm developing weakly raised distal margins and raised longitudinal striae (the latter sometimes first appearing on brr_{2-4}) that terminate in spines along distal margins. In distal half of arm, distal margins of brachials more strongly raised and spinose, sometimes slightly overlapping next brachial; aboral surface covered with short, distally directed recumbent spines. First syzygy at br_{3+4}, second usually at br_{16+17} to br_{23+24}, but sometimes beyond br_{40}; distal interval four to seven (sometimes eight or nine).

P_1 22-27 segments, 10-15 mm; proximal pinnulars short and broad; several with knob or thick rounded carina on lateral margin facing arm tip; middle and distal pinnulars much narrower and longer than wide. Proximal broadening and carina much weaker on succeeding pinnules, usually persisting to P_3 at most. P_2 similar to P_1 or shorter, of 16-24 segments, 6.5-14 mm. P_3 similar to P_2, up to 18 segments, 10 mm. P_4 usually abruptly shorter, of 10-12 segments, 4.5-6.0 mm (15 segments, 8.0 mm in one specimen). P_{6-7} usually shortest, of 9 segments, 3.8-4.4 mm. Following pinnules increasing in length and strength; middle pinnules of 16 segments, 6.2-7.0 mm; distal pinnules of 15-17 segments, 7.8-9.8 mm. Most segments of middle and distal pinnules (except basal and distal few) of about equal length, with spinose carinate margin; (L/W depends on orientation to observer).

Disk naked.

NOTES ON THREE SMALL SPECIMENS (EcCh 37, 2 spec.; EcCh 38, 1). — Centrodorsal diameter 2.2-2.5 mm; midradial height 1.1-1.4 mm; D/H 1.8-2.5. Cirri XVII-XXVI, 39-42, 21-27 mm. Arms 13-17; ray length 47 to about 55 mm. Two retain small apical cirri of 24-28 segments, 9.2-11.0 mm long.

DISTRIBUTION. — Known from the southern Philippines, Sulawesi and the Kai Islands in 245-621 m. Four of the seven stations recorded by A.H. CLARK (1931) occur in 245-320 m. The KARUBAR material was collected in 299-390 m (possibly 296-502 m).

Source : MNHN, Paris

Sp.	Sta.	Centrodorsal			Cirri			Rays	
		Diam. Base	Height	D/H	No. Cirri	Max. L	No. Segs.	No. Arms	Ray L
1	16	4.8	2.7	1.8	21			20	45+
2	16	5.6	4.0	1.4	24	42	61	19	55+
3	16	4.9	3.2	1.5	20			20	~65
4	16	5.55	4.1	1.3	26	39	55	20	~95
5	16	4.3	3.0	1.4	24			19	48+
6	16	5.1	3.9	1.3	24	39	56	20	~85
7	16	4.8	2.8	1.7	23			20	~75
8	16	5.4	3.9	1.4	29	41	61	20	
9	16	4.4	2.3	1.9	25			19	~85
10	16	4.0	2.4	1.7	21			18-19	~75
11	16	4.9	3.3	1.5	28	45	65	20	~105
12	16	5.1	4.0	1.3	24	42	60	19	~75
13	16	5.2	3.3	1.6	25	41	57	20	95
14	16	5.1	3.0	1.7	24	37	53	18	85
15	16	2.5	1.4	1.8	26	21	39	17	47
16	16	2.4	1.1	2.1	17	27	42	14	~55
17	27	3.5	2.4	1.5	25	37	58	20	~65
18	5	5.1	3.7	1.4	23			20	
19	5	6.0	3.3	1.8	23			20	~100
20	5	2.2	1.3	1.8	22	21	40	13	50
21	5	4.9	3.3	1.5	24	40	58		
n		21	21	21	21	13	13	20	15
$\overline{X}$		4.6	3.0	1.6	23.7	36.3	54.2	17.9	18.5
s		5.3	1.1	0.9	0.2	2.6	8.0	8.5	2.1

TABLE 3. — *Cosmiometra philippinensis*: measurements and statistics for 8 traits: centrodorsal, cirri and rays (n = 21). Abbreviations as in Table 2a and b.

REMARKS. — The holotype (USNM 27497, Tagolo Point, Mindanao I., Zamboanga del Norte, 08°48'44"N, 123°27'35"E, no depth, *"Albatross"* stn 5523, 10.08.1909) falls well within the range of variation exhibited by the KARUBAR specimens, with variations only in details of ornamentation, as follows: centrodorsal diameter about 4.2 mm, D/H 1.1; maximum cirrus length 40 mm. Aboral brachitaxis ornament consisting of fine spines, covering lateral thirds of Ibr_1 and best developed on lateral margins of succeeding ossicles (as in KARUBAR specimens), but also occurring in row along proximal and distal margins, and reduced but present to br_4. Arms 19; ray length about 80 mm. In some other specimens identified as *C. philippinensis* by A.H. CLARK (USNM E19176, E3214), the aboral brachitaxis ornament consists of flattened finely spinose tubercles adjacent to lateral margins, similar to that in some KARUBAR specimens.

Genus ***CROTALOMETRA*** A.H. Clark, 1909

Crotalometra rustica A.H. Clark, 1909

Fig. 7b

Crotalometra rustica A.H. Clark, 1909b: 80, 147; 1950: 91, 92, pl. 11 figs 35-36, pl. 18 fig. 58.
Crotalometra rusticata - MCKNIGHT, 1977: 106.

Source : MNHN, Paris

MATERIAL EXAMINED. — **Indonesia**. KARUBAR: *Kai Islands*: stn CP 16: 1 specimen (MNHN-EcCh 41). — Stn CP 25: 1 small specimen, broken (MNHN-EcCh 42).

DESCRIPTION OF LARGER SPECIMEN (Stn CP 16). — Centrodorsal domelike, deeply excavated midradially; diameter 11 mm; midradial height 6.5 mm; maximum interradial height 8 mm. Aboral pole flattened with weak interradial ridges. Cirri XXVIII, 64-66, 96 mm, stout (relative to most other thalassometrids); in 10 columns of two or three each; two columns of each radial area converging apically around deep midradial triangular furrow (with apical sockets not separated); columns of sockets on adjacent radial areas closely apposed interradially; c_{1-4} short; c_6 squarish; c_{7-9} barely longest, L/W 1.1; c_{10-18} almost as long but slightly more elongate (L/W 1.1-1.15) due to slight narrowing of cirrus; following segments very gradually shorter; c_{22} transitional, squarish; following several cirrals becoming shorter rapidly, L/W 0.6 by c_{28}. Distal aboral margin of c_{23} slightly raised, becoming enlarged over next several cirrals as a rounded process, rounded or rounded triangular in transverse section, never sharp or carinate. Processes on short distal cirrals with convex proximal profile and concave distal profile, the latter tilted back from distal edge of cirral and sometimes weakly dentate. Cirrus tapering distally with aboral processes weaker and more rounded. Opposing spine low rounded triangular. Terminal claw with blunted tip, as long as or longer than penultimate cirral.

Radials extremely short and concave, with irregular or weakly papillose distal margins; chiefly hidden by centrodorsal; visible to greatest degree in excavated midradial furrow of centrodorsal. Visible portion of adjacent radials just touching distal to short interradial processes of centrodorsal.

IBr2 series strongly arched and rounded, with lateral margins deeply recessed, straight, flat and apposed; Ibr_1 a shallow V-shape with few small distolateral teeth, W/L 2.8-3.3; Ibr_2 axil hexagonal or rhombic, the diverging lateral margins forming a continuous line with the proximolateral margins, W/L 1.7; synarthrial swelling broad, moderately developed; no midaboral ridge or carination.

Four rays with two IIBr4(3+4) each; one ray with two IIBr2; ossicles similar to those of IBr series but more strongly arched aborally, with moderate synarthrial swelling at $IIbrr_{1-2}$ (absent in the one smoothly rounded IIBr2 series). $IIbr_1$ with exterior lateral margin flattened and much longer than interior margin, W/L 2.3; exterior distolateral corner rough or with few weak teeth or papillae; interior distolateral corner with strong spine. $IIbr_2$ widest distally, with strong, exterior articular tubercle at $IIbrr_{2-3}$. $IIbr_{3+4}$ concave laterally, but with recessed interior lateral margin still flattened, W/L 1.1, diameter 4.4 mm.

One IIBr2 series bears a IIIBr2 interiorly and a IIIBr4(3+4) exteriorly.

Arms 22; ray length 235 mm (probably 245 mm; tips missing); brr_{1-2} similar to $IIbrr_{1-2}$ with slightly weaker synarthrial swellings; br_1 sometimes with interior distolateral spine, W/L 1.6; br_2 widest distally, flattened interiorly, W/L 1.7. Exterior articular tubercle at brr_{2-3} weaker than on brachitaxes; br_{3+4} and following brachials with strongly concave lateral margins, W/L 1.3, diameter 3.3 mm; brr_{5-10} short, oblong. Brachials becoming strongly cuneate by br_{14} and triangular by brr_{18-20}, with proximal and distal margins narrowly raised and with longer lateral margins strongly concave. Proximal brachials smooth aborally; distal midaboral margins of brachials beyond proximal fourth to third of arm finely spinose. Entire distal margin of brachials finely spinose by mid-arm, with midaboral portion of margins moderately raised and bearing stronger recumbent spines (not overlapping next brachial). Distal brachials short, cuneate, with strong midaboral spines and raised midaboral distal margins slightly overlapping next brachial. Arm profile weakly serrate.

Syzygy following br_{3+4} at br_{24+25} to br_{29+30}; next interval 11-24; distal interval 5-18.

Pinnules strongly carinate, of short segments with one or more spines at distal corners. Proximal segments of proximal two or three pinnules with abambulacral surface flattened to conform with close lateral apposition of rays, and with strong, sometimes spinose carinae along both ab- and adambulacral edges of lateral margins facing arm tip. Arms too closely apposed to examine most oral pinnules, but one P_2 of 32 segments, 18 mm long.

DESCRIPTION OF SMALLER SPECIMEN (Stn 25, EcCh 42, Fig. 7B). — *Features differing from the preceding*: Centrodorsal conical with triangular interradial extensions; midradial margin not excavated; diameter 5.4 mm, maximum height 4.5 mm, midradial height 4.1 mm. Aboral pole papillose; papillae derived from obsolete cirrus

Source : MNHN, Paris

sockets, small and slender at apex, larger smooth and convex nearer apical functional sockets. Peripheral sockets slightly separated midradially.

Cirri XXII, 55-56, 62 mm; c_{1-3} short; c_5 squarish; c_6-c_{12} longest, equally long, L/W 1.1-1.3 (more distal cirrals slightly narrower); c_{13} transitional, slightly longer than wide, with weakly spinose distal aboral margin; c_{14} squarish with slightly raised spinose aboral distal end. Following cirrals becoming shorter, with distal aboral margin developing into triangular spine (never taller than its basal length). Spine with slightly convex proximal profile and slightly concave dentate distal profile; low and rounded on distal few cirrals as cirrus tapers to tip.

Radials exposed but shorter than Ibr_1, with smooth midradial swelling or low rounded tubercle; swollen laterally against adjacent radial and triangular interradial extension of centrodorsal. IBr series strongly rounded aborally with low, smoothly rounded synarthry; lateral margins of ossicles everted and thickened but recessed and barely apposed. Ibr_1 with recessed distolateral corners everted and bearing one or two teeth, W/L 3.1; Ibr_2 axil hexagonal with lateral margins recessed, everted and weakly dentate or rugose, especially at proximolateral corner, W/L 1.7.

All IIBr4(3+4); similar to IBr series; laterally flattened and apposed interiorly, with weak rounded synarthrial swelling. $IIbr_1$ with exterior margin strongly thickened, everted, flat-sided, with distolateral corner rugose or weakly spinose or dentate; $IIbr_2$ with exterior margin and proximolateral corner similar to those of $IIbr_1$; $IIbr_3$ with exterior margin smooth; $IIbr_4$ with recessed exterior margin flared and spinose.

Arms 19 or 20; ray length 120 mm; brr_{1-2} similar to $IIbrr_{1-2}$, with few exterior spines; br_{3+4} 2.1 mm across, W/L 1.3; brr_{5-9} oblong with one or a few weak spines along their slightly longer lateral margins. Distal aboral margins weakly raised and finely spinose beyond proximal third of arm; by mid-arm, distal margins of brachials more strongly raised, spinose, with long recumbent spines sometimes slightly overlapping next brachial.

Pinnules similar to those of large specimen. Proximal two or three pinnules with finely spinose or dentate adambulacral carina along lateral margin of proximal segments (side facing arm tip).

DISTRIBUTION. — A.H. CLARK (1931) recorded this species from north of Halmahera (Indonesia), Taiwan, the Nicobar Islands and Madras, India, in 55 to possibly 2047 m. MCKNIGHT (1977) recorded it (as *C. rusticata*) off northern New Zealand. ROWE and GATES (1995) cited additional material in the Western Australia Museum (Perth) from Dampier to Rowley Shoals, northwestern Australia, in 306-508 m. The KARUBAR specimens (336-346 m, possibly 315-349 m), fall well within this latter depth range.

REMARKS. — Both specimens fit A.H. CLARK's generic diagnosis of *Crotalometra* and appear to represent the same species. They have been described separately to better illustrate the differences associated with their vastly different sizes. A.H. CLARK (1950) recognized three species in the genus, and says that "The only reliable feature for specific differentiation . . . appears to be the relative production of the distal dorsal [= aboral] edge of the outer brachials" (p. 90). However, A.M. CLARK (1967) noted that some specimens identified by A.H. CLARK as *C. sentifera* A.H. Clark bear $br_{1+2,\ 3+4}$ on arms arising from IIBr4(3+4) series instead of just br_{3+4} as in *C. rustica* A.H. Clark and *C. magnicirra* (Bell). She describes two additional specimens as *C.* sp., *?sentifera* also bearing $br_{1+2,\ 3+4}$. In addition to having the first brachial syzygy at br_{3+4}, the two KARUBAR specimens most closely approach *C. rustica* in having the distal aboral edges of the middle and distal brachials "somewhat produced and spinous" (A.H. CLARK, 1950: 91). However, A.H. CLARK (1950: 96) also refered to specimens in which this feature is very prominent and overlapping or with an "abrupt tuft or fin of rather long spines", approaching his diagnosis of *C. sentifera*.

The large specimen is, to our knowledge, the largest thalassometrid ever recorded. Arm length exceeds the largest previously known by at least 50 mm [180 mm in *Oceanometra gigantea* (A.H. Clark)]. The cirri are about as long as the maximum recorded (95 mm in *Leilametra necopinata* A.H. Clark, which has up to 83 unusually elongated cirrals), but they are shorter relative to arm length than in many other thalassometrids. The much shorter cirri of *Parametra* spp. are an exception, but this genus is transitional with the Charitometridae, which also bear relatively short cirri.

Source : MNHN, Paris

Genus *OCEANOMETRA* A.H. Clark, 1916

Oceanometra annandalei (A.H. Clark, 1909)

Figs 11d, 12a, 16-18, 29-38; Tables 4a-b

Crotalometra eupedata - A.H. CLARK, 1909c: 406 (part).
Crotalometra annandalei A.H. Clark, 1909d: 642.
Thalassometra annandalei - A.H. CLARK, 1911: 551.
Thalassometra magna A.H. Clark, 1912b: 425.
Oceanometra annandalei - A.H. CLARK, 1916: 606; 1918: 151, 153; 1950:138, 144, pl. 15 figs 45-46.
Oceanometra magna - A.H. CLARK, 1916: 606; 1918: ix, 151, 274, pl. 22 fig. 57; 1921: 171, fig. 221; 1950: 138, 142, pl. 14 figs 42-43.

MATERIAL EXAMINED. — **Indonesia**. KARUBAR, *Kai Islands*: stn CP 05: 1 specimen (MNHN-EcCh 52). — Stn CP 16: 8 specimens (MNHN-EcCh 51). — *Tanimbar Islands*: stn CP 83: 8 specimens (MNHN-EcCh 48); 12 specimens (MNHN-EcCh 49); 12 specimens (MNHN-EcCh 50).

DESCRIPTION. — Centrodorsal domelike or rounded conical (sometimes apically flattened or truncated), with narrow, usually short interradial projections, and sometimes with narrow, rarely spinose interradial ridges; midradial margin usually excavated; basal diameter 3.5-6.8 mm; midradial height 3.5-6.0 mm. Aboral pole 1.4-3.7 mm across, domelike, rounded conical, flat or irregular; papillose, spinose, rugose or tuberculate, rarely smooth or with irregular interradial ridges. Cirri in ten columns, two per radial area, of up to five sockets each; adjacent columns closely crowded interradially, separated midradially by flat to deeply concave triangular area; apical sockets contiguous midradially.

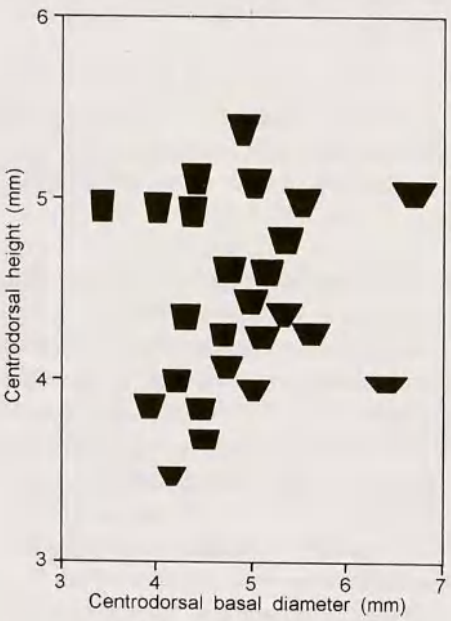

FIG. 16. — *Oceanometra annandalei*. Plot of basal diameter versus midradial height of centrodorsal. Individual data points show centrodorsal shape (derived from height, basal diameter and apical diameter measurements).

Cirri XXVII-XLIX, 61-91, maximum length 42-83 mm, long and slender; c_1 to c_{3-5} short, increasing in length; next one or two cirrals squarish (LW ≅ 1.0). Following cirrals in proximal third of cirrus longer than wide; one to three cirrals between c_5 and c_{16} longest (chiefly c_7 in specimens from stn CP 16; chiefly c_{12} in specimens from stn CP 83); L/W of longest cirral chiefly 1.4-2.2 (extremes: 1.3-2.3); cirrals in distal 40% of cirrus shorter than wide. Transitional cirral c_7-c_{13} (c_7 in specimens from stn CP 16; chiefly c_{11-13} in specimens from stn CP 83). Distal aboral margin first slightly raised between c_{15} and c_{27}, gradually enlarging and becoming distal triangular spine; accompanied by increasing compression and aboral carination of cirrals. Aboral margin of middle cirrals straight, convex or gently sinuous, sloping up to distal spine, with distal profile of spine straight or slightly concave. Spines triangular or rounded triangular in cross section; distal margin of spines sometimes finely spinose or dentate on distal cirrals; spines often weaker, rounded (sometimes still sharp, rarely hooked) on distal few segments. Opposing spine triangular or blunt. Terminal claw gently curved, slightly longer than penultimate cirral.

Radials short, with midradial tubercle or 1-3 spines; swollen laterally with 0-2 spines (or tubercle); distal margin smooth, spinose or dentate.

Brachitaxes IBr2; II and IIIBr series chiefly 4(3+4), occasionally of 2 ossicles (one specimen with two IIBr4 bearing synarthries at $IIbr_{1—2}$ and $IIbr_{3—4}$); IIIBr interior or exterior. Ibr_1 very short, shallowly U- or V-shaped, W/L chiefly 3.6-5.5 (range: 3.0-7.5); Ibr_2 axil hexagonal, W/L chiefly 1.3-1.5 (range: 1.0-2.2). $IIbr_1$ longer exteriorly, W/L chiefly 3.0-4.8 (range: 2.1-9.0); $IIbr_2$

Source : MNHN, Paris

larger, convex proximally, W/L chiefly 1.4-2.0 (range: 1.2-2.7); $IIbr_{3+4}$ W/L chiefly 0.9-1.4 (range: 0.9-6.8). Brachitaxes strongly arched; narrow midaboral ridge low to moderately developed, smooth, spinose or irregularly dentate, rarely with large proximal or distal tooth (ridge reduced on $IIbr_1$ of one specimen to single distal spine or tooth), rarely T- or Y-shaped on $IIbr_2$ axil; proximal and distal margins of ossicles smooth, spinose or dentate; spines or teeth often weaker midaborally. Lateral margins of IBr and IIBr series ranging from weakly everted to

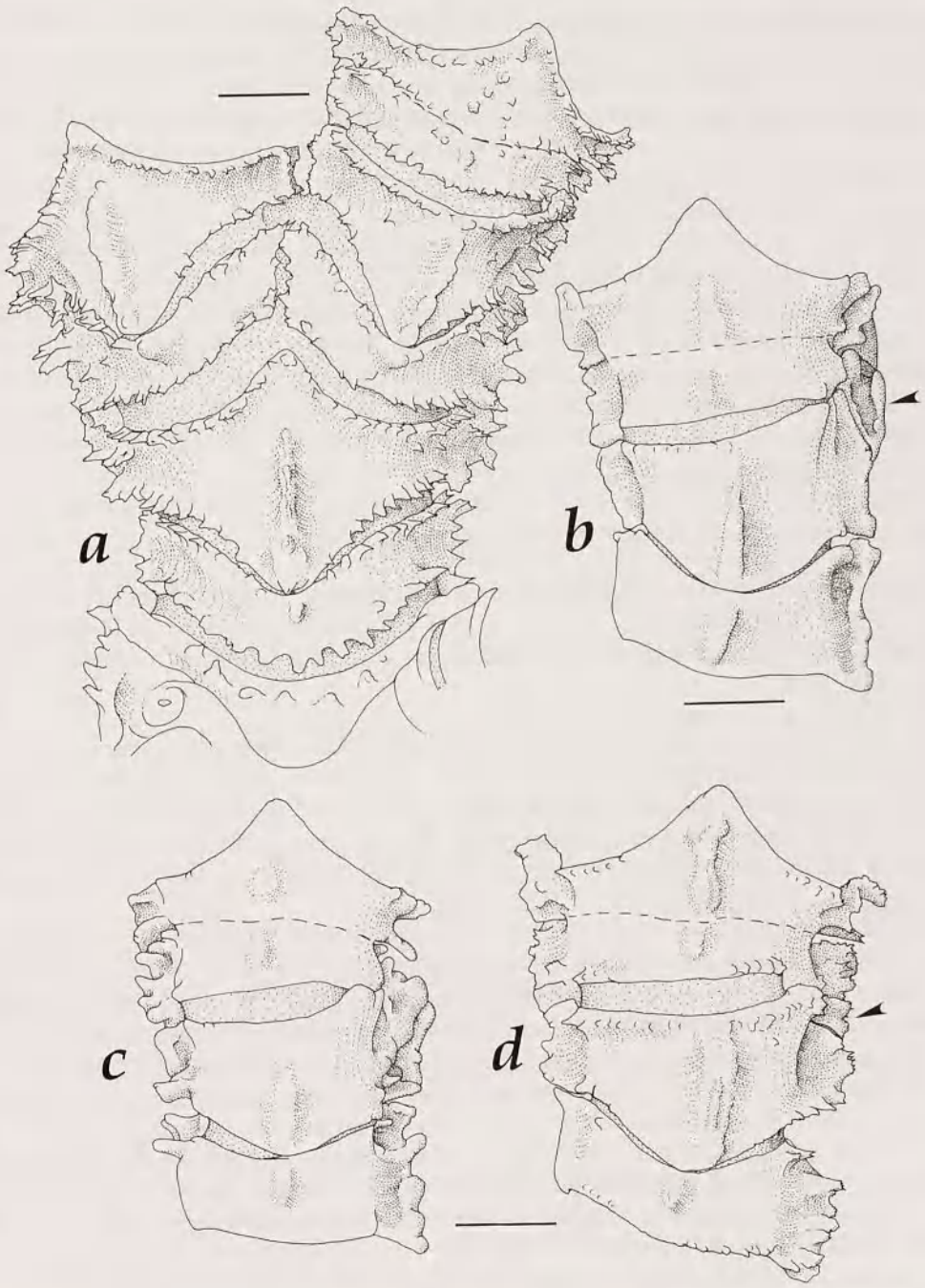

FIG. 17. — *Oceanometra annandalei* : **a**, aboral view of base of one ray of specimen showing elaborate ornamentation (EcCh 51); **b-d**, IIBr4(3+4) series of three specimens showing variations in ornamentation (b-c, EcCh 49; d, EcCh 51). Arrows indicate bases of P_{II}. Scale bars = 1.0 mm.

Source : MNHN, Paris

thickened and flared, sometimes flat-sided and apposed, with few to many spines, teeth or papillae; strongly flared margins sometimes forming concave pocket along lateral portion of aboral surface of ossicles; lateral ornamentation on IIBr occasionally coalesced into irregular lamellae; midaboral ridge and ornamentation on IIIBr often weaker and sparse, with flaring of lateral margins and ornamentation often weak or absent. Scattered aboral spines or papillae sometimes present. In a few specimens with reduced ornamentation, Ibr_1 with one or few spines, teeth or papillae at distolateral corners, and Ibr_2 axil and IIBr series with weakly papillose, irregular lateral margins.

Arms 13-32; ray length 84-150 mm. Midaboral ridge continued on brr_{1-2}; flaring and ornamentation of brachitaxes usually persisting to brr_{2-4} (sometimes as far as brr_{7-9}), but lateral margins often not flared or everted, and ridge and ornamentation typically weaker than on brachitaxes; midaboral ridge sometimes persisting as low swelling beyond mid-arm. Crowded low aboral papillae or fine spines first appear on brr_{2-4}, becoming recumbent and elongated as narrow striations, so that brachials develop spinose distal margins by brr_{16-20}. Brachials oblong or slightly cuneate to br_{11}, strongly cuneate by brr_{13-14}. Distal brachials short, cuneate, compressed, with raised and more strongly spinose distal aboral margins. One arm of one specimen with brr_{5-8} duplicating the articulations of brr_{1-4} (i.e., a synarthry at brr_{5-6} followed by br_{7+8}).

Pinnules becoming progressively smaller, from heavy robust P_{II} to small slender P_5-P_7. P_{II} up to 31 segments, 13.2 mm long. P_1 up to 35 segments, 20.6 mm. P_2 up to 21 segments, 7.6 mm. Short P_5-P_7 of 13-16 segments, 4.4-6.0 mm (P_4 sometimes as short as P_5-P_6). Middle pinnules small and slender, becoming longer, wider and more robust distally. Distal pinnules of 14-22 segments (chiefly 16-17), 7.0-17.5 mm long (chiefly 7.0-10.0 mm). Proximal abambulacral surface of P_{II} (and to lesser degree P_1) often flattened to conform to flat-sided and apposed proximal brr; sometimes rugose, spinose or papillose (corresponding to lateral ornamentation of brachitaxes). Lateral margins of basal pinnulars variably spinose; numbers of spines decreasing from P_1 to P_4. Lateral margin (facing arm tip) of proximal pinnulars of P_{II} (sometimes to P_{1-2}) sometimes carinate; carina smooth, spinose or dentate; following pinnules with spines only at distal corners of pinnulars.

Disk densely covered with small irregular or rounded, elongate nodules.

DISTRIBUTION. — Known from the Philippines and eastern Indonesia (Kai and Tanimbar Islands, Timor). The depth range given by A.H. CLARK (1950) is 204-510 m (not including two anomalously shallow records: 55 and 124 m) with most material recorded from about 290-390 m. The KARUBAR specimens were collected in 297-315 m (possibly 285-349 m).

REMARKS. — A.H. CLARK (1950) recognized three species of *Oceanometra*: *O. gigantea* (A.H. Clark) from Hawaii, *O. magna* (A.H. Clark) from Indonesia, and *O. annandalei* (A.H. Clark) from Malaysia and the Philippines. He distinguishes *O. gigantea* from the other two by a midaboral ridge on Ibr_2, $IIbr_2$ and br_2, but not on Ibr_1, $IIbr_1$ or br_1. One KARUBAR specimen approaches *O. gigantea* in having the midaboral ridge reduced to a spine or tooth on the brachitaxes. However, because *O. gigantea* is currently known only from the Hawaiian chain, we maintain it as distinct herein.

Oceanometra magna and *O. annandalei* present a different problem. According to A.H. CLARK's diagnoses (1950: 138, 145), the two appear quite distinct: *O. magna* bears spines only along ossicle margins and midaboral ridge, and has lateral margins of brachitaxes produced and irregularly dentate; *O. annandalei* bears aborally spinose brachitaxes and arm bases, and the lateral brachitaxes margins are not produced. However, A.H. CLARK's detailed description of *O. annandalei* squarely contradicts his diagnosis: "the lateral edges [of Ibr_1] are more or less denticulate, and there is a low, though sharp, serrate median keel"; "the lateral edges [of Ibr_2 are] somewhat denticulate; there is a sharp serrate median keel in the proximal two-thirds"; "the lateral edges [of the IIBr series] are produced and strongly denticulate", and "The dorsal [= aboral], but not the dorsolateral, side of the fourth and following brachials is covered with fine short spines which gradually become coarser after the proximal third of the arm and tend to arrange themselves in longitudinal lines. The ossicles of the division series and arm bases have strongly denticulate borders" (pp. 145-6). These are virtually identical to the description of *O. magna*. A.H. CLARK's description of *O. annandalei* never mentions "the more or less spinous dorsal surface" (p. 145) of the brachitaxis ossicles and first two brachials found in his diagnosis. We treat the two species as synonyms.

A.M. CLARK (1967) recognized another species, *O. valdiviae* from 1644 m off Somalia, but notes that the "species proved very difficult to place by means of A.H. CLARK's key to the genera of Thalassometridae"

Source : MNHN, Paris

(1967: 156). It differs from *O. annandalei* in bearing a more strongly excavated midradial centrodorsal margin, a raised wedge-shaped area on the centrodorsal that separates the columns of cirrus sockets midradially, more numerous pinnulars on the oral pinnules, and a scattering of fine rugosities all over the brachitaxes and arm ossicles. It lacks the midaboral ridge characteristic of the brachitaxes of *O. annandalei*.

Oceanometra supposedly differs from *Thalassometra* "only in the greater number of arms; in the occurrence of keels on one or both elements of the pairs of ossicles in the division series and first two brachials; and in having P_2 intermediate in character between P_1 and P_3 instead of small and similar to the following pinnules" (A.H. CLARK, 1950: 138). The difference in arm number between the two may be ontogenetic at least in some species. A.H. CLARK also recorded midaboral carinae on the brachitaxes and proximal brachials of *T. gracilis* (Carpenter) and *T. hirsuta* A.H. Clark (spinose in the latter), and A.M. CLARK (1967) discussed several features shared by *O. valdiviae* and *T. attenuata* A.H. Clark. It is likely that at least some species of *Thalassometra* and *Oceanometra* will prove congeneric.

Sp.	Sta.	Centrodorsal					Cirri							Longest cirral				P_1		P_{middle}		P_{distal}	
		Diameter		Height	D/H	S	No.	Max.	No.	Trans.	First	Cirri/	U	Seg.	L	W	L/W	L	No.	L	No.	L	No.
		Pole	Base				Cirri	L	Segs.	Seg.	Spine	Col.		No.					Segs.		Segs.		Segs.
1	83	3.0	4.4	4.4	1.0	30.4	31	53	64	11	17	3	1.0	12	1.4	0.8	1.9	**4.6**	17	4.4	13	7.2	16
2	83	3.5	4.9	4.6	1.1	35.6	34	63	81		20	3	1.0	12	***2.0***	0.9	***2.3***	13.1	30	6.2	15	**6.9**	**14**
3	83	2.9	4.3	5.0	0.9	33.8	31	72	79	11	16	3	0.9	12	1.6	0.8	2.0	7.1	**11**	4.8	12		
4	83	2.8	**3.5**	5.0	**0.7**	27.5	32	68	77	13	19	3	1.2	12	1.8	0.8	2.2	9.5	27	3.8	**9**	9.5	17
5	83	2.3	4.3	5.0	0.9	33.9	30	54	65	12	17	3	0.9	12	1.4	1.0	1.5	14.8	28	***7.4***	16	9.9	19
6	83	2.0	5.6	5.0	1.1	43.6	29	55	68	13	***22***	3	0.7	12	**1.1**	**0.6**	2.0	8.6	11	4.0	14	7.7	17
7	83	***3.7***	5.4	4.8	1.1	40.7	31	69	72	12	17	3	0.8	12	1.8	1.0	1.8	8.6	23	5.6	12	9.5	20
8	83	2.8	4.0	3.9	1.0	24.5	29	60	71		17	3	1.2	***16***				7.1	25	4.8	10	7.7	17
9	83	2.7	4.3	4.0	1.1	26.9	**27**	42	**61**	10	14	3	1.0	10	1.4	0.9	1.7	9.1	27	6.2	12	7.4	15
10	83	3.2	4.6	3.7	1.2	26.7	28	63	68	12	19	3	1.0	12	1.5	0.7	**2.3**	8.6	17	4.9	14	8.6	16
11	83	2.5	4.2	5.0	0.8	32.9	34	54	65	12	16	3	1.0	12	1.4	0.7	2.1	11.4	29	5.3	15	8.9	18
12	83	2.5	5.1	4.5	1.1	35.9	35	53	62	10	14	4	1.0	10	**1.1**	0.7	1.7	7.6	23	3.9	13		
13	83	2.4	***6.8***	5.0	1.3	53.5	41	62	68	8	19	4	0.8	8	1.8	***1.2***	1.5	15.3	30	6.2	14	9.3	16
A	16	**1.4**	4.0	***6.0***	**0.7**	37.7	41	70	71	7	14	4	1.1	**7**	1.8	***1.2***	1.5	***20.6***	***35***	6.4	***17***	***17.5***	15
AA	83	2.9	4.5	3.9	1.1	27.4	30	64	72	11	16	3	1.1	11				12.0	28	4.2	13	7.6	14
B	16	2.6	6.5	4.0	***1.6***	40.7	***49***	***83***	72	7	15	5	1.2	**7**	***2.0***	1.1	1.9	19.1	29	4.8	11	7.3	16
C	16	1.9	5.2	***6.0***	0.9	49.4	38	55		7	18	4	0.8	8	1.6	***1.2***	**1.3**	13.6	25	5.6	13	8.3	17
D	16	1.8	5.0	5.4	0.9	42.4	35					4	0.8					14.3	28	5.2	12	7.5	16
E	16	1.4	4.9	4.6	1.1	35.4	34					3	1.0					10.8	27	5.2	15	8.9	19
F	16	1.3	5.4	4.4	1.2	37.3	33			7	**13**	3	0.9	**7**	1.5	1.0	1.6	15.2	31	5.2	14	8.4	16
G	16	1.5	5.0	4.0	1.3	31.4	30					3	1.0					14.8	26	6.2	13	11.7	17
H	16	1.2	4.3	**3.5**	1.2	23.5	33	55	67	7	19	3	1.4	**7**	1.4	1.0	1.5	11.4	25	**3.7**	10	8.2	16
J	83	2.5	4.5	5.1	0.9	35.7	33	**42**	71	12	**13**	3	0.9	12	1.3	**0.6**	***2.3***	10.5	27	4.8	13	8.1	17
M	83	2.1	4.8	4.1	1.2	30.9	30	62	73	11	15	3	1.0	11	1.6	0.8	2.1	10.5	20	6.4	16	8.8	18
P	83	3.0	5.0	4.6	1.1	36.1	38					4	1.1					10.9	24	6.2	15	10.0	18
W	83	2.2	4.8	4.3	1.1	32.1	**27**	72	76	13	18	3	0.8	13	1.4	1.0	1.5	11.4	24	6.2	15	9.7	***22***
Y	83	2.2	5.1	5.1	1.0	40.7	33	80	***91***	12	20	3	0.8	12	1.5	0.9	1.7	8.6	29	4.8	16	9.7	20
n		27	27	27	27	27	27	22	21	21	23	27	27	23	21	21	21	27	27	27	27	25	25
$\bar{X}$		2.4	4.8	4.6	1.1	35.1	33	61	71	10	17	3	1.0	11	1.4	0.8	1.7	11.4	25.0	5.3	13.4	9.0	17
Mode							30	55	68	12	17	3		12	1.4	1	1.5	8.57	27	4.8	13	9.5	16
s		0.7	0.7	0.6	0.2	7.2	4.9	10.6	7.0	2.2	2.4	0.5	0.2	2.4	0.2	0.2	0.3	3.7	5.7	1.0	2.0	2.1	1.9
V (%)		28.1	14.8	13.8	19.0	20.5	14.7	17.2	9.8	21.6	14.4	16.4	16.6	22.0	16.0	24.5	18.6	32.2	22.6	18.2	15.0	23.4	11.2

TABLE 4a. — *Oceanometra annandalei*: measurements and statistics for 22 traits: centrodorsal, cirri and pinnules (n = 27). Abbreviations: *Trans. Seg.*, transition segment, counting from cirrus base. Other abbreviations as in Table 2a.

ON VARIATIONS. — If specimen B, which bears several anomalously short proximal ray ossicles, is omitted from consideration, coefficients of variation of all measured traits range from 9.8 (numbers of cirrals) to 30.7% (P_1 length) (Tables 4a-b). As with *Aglaometra valida*, the variability must be treated carefully. Figure 16 shows that, although centrodorsal height varies less than in *A. valida* (see Fig. 14a), proportions based on polar and aboral diameters and height show no clear pattern relative to centrodorsal size.

Centrodorsal surface area (S; see *Aglaometra valida* above for calculations) varies from 23.5 to 53.5 mm^2 with V = 20.5%; the number of cirri per unit surface area (U) varies from 0.7 to 1.40 cirri mm^{-2}. As with *A. valida*, the wide range of the latter suggests that the number of cirri is not correlated with centrodorsal surface area. A bivariate

Source : MNHN, Paris

Sp.	Sta.	Rays																										
		Ray	No.	Ibr_1			Ibr_2			$IIbr_1$			$IIbr_2$			$IIbr_{3+4}$			br_1			br_2			br_{3+4}		
		L	Arms	L	W	W/L	L	W	W/L	L	W	W/L	L	W	W/L	L	W	W/L	L	W	W/L	L	W	W/L	L	W	W/L
1	83	120	20	0.7	**2.4**	3.6	2.0	3.7	1.9	0.7	2.0	3.0	1.8	2.6	1.4	1.9	1.7	**0.9**	0.7	1.8	2.7	1.4	1.9	**1.3**	1.9	1.7	0.9
2	83	123	20	0.9	3.1	3.6	**2.6**	2.7	**1.0**	0.9	2.6	3.0	***2.4***	***3.3***	1.4	***2.5***	2.2	**0.9**	***0.9***	2.4	2.7	***1.9***	2.5	**1.3**	***2.5***	2.2	0.9
3	83		18	0.6	2.5	4.4	1.9	3.1	1.6	0.6	2.2	3.8	1.1	1.9	1.7	1.5	**1.6**	1.1	**0.5**	**1.4**	3.0	1.0	1.6	1.7	1.2	1.5	1.2
4	83	100	19	0.6	2.7	4.3	2.2	2.8	1.3	0.6	2.5	4.1	1.2	2.1	1.8	2.1	2.1	1.0	**0.5**	1.9	3.4	1.2	1.8	1.5	1.5	1.5	1.1
5	83	***150***	20	0.7	2.7	3.7	2.2	3.1	1.4	0.7	**1.8**	2.7	1.2	**1.8**	1.4	2.1	2.1	1.0	0.6	2.1	3.6	1.1	1.8	1.7	1.2	1.8	1.5
6	83	92	**13**	**0.4**	2.7	7.0	2.3	3.0	1.3	0.5	2.1	4.4	1.2	2.2	1.8	1.8	1.7	**0.9**	0.6	1.5	2.7	1.0	**1.5**	1.6	1.3	1.4	1.1
7	83	140	20	0.8	2.8	3.6	2.1	2.9	1.4	0.7	2.0	3.0	1.2	2.2	1.8	2.0	2.9	1.4	0.7	2.4	3.6	**0.6**	2.1	***3.7***	1.3	1.5	1.1
8	83	91	20	0.6	**2.4**	4.2	1.9	2.9	1.5	0.6	2.4	4.2	1.1	2.6	2.3	1.8	2.4	1.3	0.6	1.9	3.3	1.0	1.7	1.8	1.4	1.4	1.0
9	83	99	20	0.5	2.7	5.6	2.2	2.9	1.3	0.6	2.4	4.2	1.3	2.2	1.6	1.9	2.3	1.2	0.6	1.5	2.7	1.1	1.6	1.5	1.1	1.7	1.5
10	83	113	20	0.5	2.9	6.0	2.2	3.0	1.3	0.5	2.3	4.8	1.2	2.3	1.8	1.9	2.6	1.4	0.6	1.5	2.7	1.1	1.6	1.5	1.3	1.7	1.3
11	83	118	17	0.6	2.6	4.5	1.9	2.9	1.5	0.6	2.4	4.2	1.1	2.5	2.2	1.8	2.6	1.4	0.6	1.8	3.2	1.0	1.9	2.0	1.1	1.9	1.7
12	83		17	***1.0***	2.9	**3.0**	2.1	***4.4***	2.1	***1.0***	2.0	**2.1**	1.3	2.4	1.8	2.0	2.3	1.1	0.8	1.8	2.4	1.0	1.7	1.8	1.4	1.4	1.0
13	83	141	28	0.8	***4.0***	5.0	2.4	3.5	1.5	0.5	3.2	6.6	1.8	3.2	1.8	1.9	***3.3***	1.8	**0.5**	***2.7***	***5.6***	1.6	***2.7***	1.7	1.9	***2.5***	1.3
A	16	94	24	0.8	3.1	4.0	2.2	**2.6**	1.2	0.7	2.3	3.4	1.9	2.7	1.4	1.9	2.8	1.5	0.6	2.1	3.7	1.2	2.1	1.7	1.1	1.9	1.7
AA	83	140	20	0.8	2.7	3.5	1.8	4.0	***2.2***	0.7	2.1	3.1	1.1	2.3	2.0	1.9	2.4	1.3	0.6	2.2	3.8	1.0	1.8	1.9	1.2	1.7	1.4
B	16	114	***32***	0.5	3.6	***7.5***	***2.6***	3.0	1.1	**0.4**	3.4	***9.0***	2.2	2.6	**1.2**	**0.4**	2.6	***6.8***	0.7	2.0	3.0	1.1	1.9	1.7	1.6	1.9	1.2
C	16	110	***32***	0.6	2.7	4.7	2.1	3.1	1.5	**0.4**	2.5	6.5	1.1	2.2	1.9	1.8	2.4	1.3	**0.5**	2.1	4.4	1.0	1.9	2.0	1.6	**1.2**	**0.8**
D	16	122	24	0.6	3.1	5.4	2.3	3.3	1.5	0.6	***3.5***	6.2	1.3	2.6	1.9	2.1	3.1	1.5	0.7	2.0	3.0	1.1	2.1	1.8	1.2	1.7	1.4
E	16	105	20	0.7	2.9	4.3	2.1	3.2	1.5	0.6	1.9	3.3	1.2	2.4	1.9	1.6	2.6	1.6	**0.5**	1.9	4.0	1.1	2.0	1.9	1.1	1.8	1.6
F	16	136	26	0.7	3.1	4.6	2.2	3.2	1.5	0.7	2.4	3.6	1.1	2.3	2.0	2.0	2.3	1.1	0.6	2.1	3.7	1.1	1.9	1.8	1.1	1.7	1.6
G	16	135	22	0.7	3.3	5.0	2.4	2.7	1.1	0.6	2.5	4.4	1.1	2.3	2.0	1.9	2.1	1.1	0.6	2.0	3.5	1.1	1.9	1.7	1.1	1.9	1.8
H	16	**84**	18	0.6	2.5	4.0	1.9	2.8	1.5	0.5	1.9	3.6	1.1	2.1	1.9	1.7	2.0	1.2	0.6	1.4	**2.2**	1.0	1.6	1.6	1.2	1.6	1.4
J	83	125	20	0.6	2.5	4.4	**1.7**	3.7	***2.2***	0.6	2.2	3.8	1.2	2.3	1.8	1.5	2.7	1.8	0.6	1.9	3.3	1.0	1.8	1.9	1.2	1.6	1.3
M	83	123	19	0.7	2.7	4.0	2.0	3.1	1.5	0.6	2.8	4.8	1.1	2.4	2.1	1.9	2.4	1.3	0.6	1.8	3.2	1.0	1.7	1.8	1.1	1.4	1.3
P	83	135	20	0.6	3.1	5.5	2.1	3.2	1.5	0.6	3.1	5.5	1.3	2.6	1.9	2.3	2.3	1.0	0.6	1.9	3.3	1.1	1.8	1.6	1.3	2.0	1.5
W	83	125	16	0.6	2.5	4.4	**1.7**	3.3	1.9	0.6	2.4	4.2	**0.9**	2.3	***2.7***	1.1	2.4	2.1	0.6	2.0	3.5	1.0	1.8	1.9	1.1	2.0	***1.9***
Y	83	122	21	0.9	2.7	3.1	2.0			0.5	2.2	4.6	1.6	2.2	1.4	2.1	2.6	1.2	0.7	2.1	3.1	1.1	1.9	1.8	1.2	1.9	1.5
n		25	27	27	27	27	27	26	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
$\bar{X}$		118	21.0	0.6	2.8	4.5	2.1	3.1	**1.5**	0.6	2.4	4.3	1.4	2.4	1.8	1.8	2.4	1.5	0.6	1.9	3.3	1.1	1.9	1.8	1.4	1.7	1.3
Mode			20			4.4			1.5			4.2			2.0			1.0			2.7			1.8			1.0
s		17.9	4.4	0.1	0.4	1.1	0.2	0.4	0.4	0.1	0.5	1.5	0.4	0.3	0.3	0.4	0.4	1.1	0.1	0.3	0.7	0.2	0.3	0.4	0.3	0.3	0.3
V (%)		15.1	20.8	20.4	13.3	23.8	10.8	13.8	29.0	20.6	18.9	34.0	26.0	13.9	17.5	21.1	16.4	73.8	14.4	15.5	20.6	21.9	13.6	23.2	23.6	16.5	21.7

TABLE 4b. — *Oceanometra annandalei*: measurements and statistics for 26 traits: rays (n = 27). Abbreviations: *No. Arms*, arm number. Other abbreviations as in Table 2b.

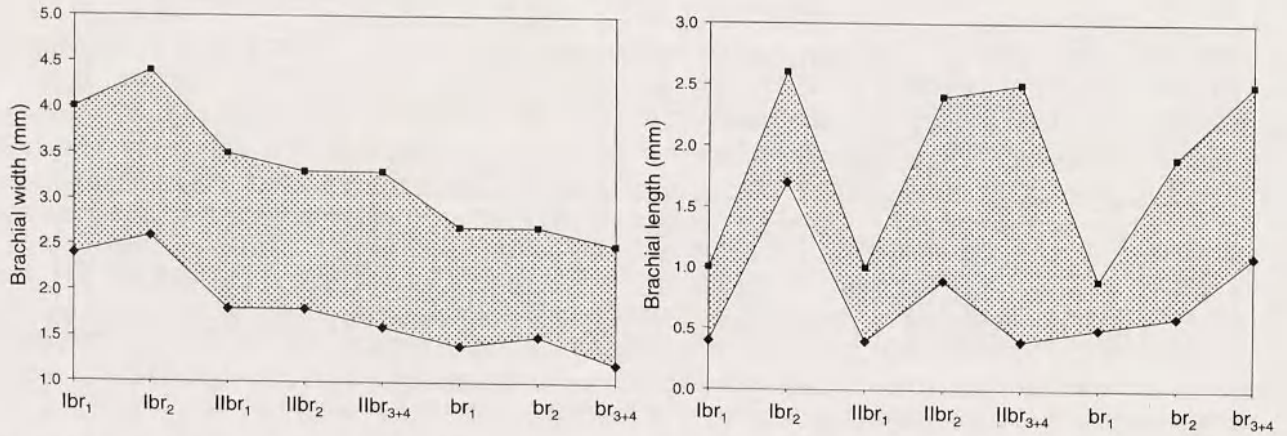

FIG. 18. — *Oceanometra annandalei*: Maximum (squares) and minimum (diamonds) widths (left) and lengths (right) of proximal ray ossicles (Ibr_1, Ibr_2, $IIbr_1$, $IIbr_2$, $IIbr_{3+4}$, br_1, br_2, br_{3+4}) (n = 27).

analysis (not shown here) shows that the crowding of cirri correlates with basal centrodorsal diameter (r = 0.70, with specimen B omitted), but not with aboral diameter. Simply put, number of cirri increases with centrodorsal size. If the centrodorsal enlarges with age, the relatively narrow range of centrodorsal basal diameters (85% range from 4.0 to 5.4 mm) suggests that the populations represented in the KARUBAR collection are relatively age homogenous.

Source : MNHN, Paris

In *Oceanometra annandalei*, variability in the width of proximal ray ossicles remains about the same through the brachitaxes and decreases slightly on proximal brachials of the free arm (br_1-br_{3+4}) (Fig. 18, left). Unlike *A. valida* (Fig. 14b, top), the width of Ibr_1 is not substantially more variable than that of succeeding ossicles.

The second ossicle in a brachitaxis or free arm of both species is longer than the first (e.g., Ibr_2 and br_2 longer than Ibr_1 and br_1, respectively), a feature typical of most comatulids. However, in *O. annandalei*, the length of the Ibr_2 axil is far less variable (Fig. 18, right) than the same ossicle in *A. valida* (Fig. 14b, bottom). Instead, the broad variability found in Ibr_2 of *A. valida* appears in $IIbr_2$ and $IIbr_{3+4}$ of *O. annandalei*. Variability in ossicle length thus appears to be associated with the ossicle(s) immediately preceding the free arm. It seems likely that proportions of the axil immediately proximal to the free arm ($IIbr_{3+4}$ in *O. annandalei*) may affect the range of arm movement more than the proportions of more proximal ossicles that support the viscera. Alternatively, variations in stress on feeding arms due to different flow regimes may force variations in terminal axil proportions.

Genus ***STENOMETRA*** A.H. Clark, 1909

REMARKS. — Examination of the KARUBAR material together with a re-examination of some previously collected specimens forces a re-organization of *Stenometra*. A complete revision awaits examination of more type material, however. In the most current treatment of the entire genus, A.H. CLARK (1950) recognized four species based on variations in ornament of brachitaxes and proximal brachials, and on proportions of longest cirrals, as follows: *S. diadema* (A.H. Clark) and *S. quinquecostata* (Carpenter) lack any eversion or swelling of, and bear few if any spines or teeth on proximal ossicles; the longest cirrals of their slender cirri are at least twice as long as wide. Midaboral ridges are dentate in *S. diadema* and smooth in *S. quinquecostata*. A.H. CLARK treated *S. cristata* A.H. Clark as a synonym of *S. quinquecostata*.

In *S. dentata* Gislén and *S. snelliusi* A.H. Clark, the ossicles have everted and spinose or denticulate margins and the longest cirrals have L/W ≤ 1.5. *S. dentata* has strongly produced and lobate or coarsely spinose ossicles, numerous long lateral tubercles or spines, and a "supplementary prominence" on each side of the aboral ridge on some proximal brachials. *S. snelliusi* lacks the produced margins and brachial prominence, and has weaker spines (A.H. CLARK, 1950: 7-8). The KARUBAR collection contains two clearly distinct species of *Stenometra*. Diagnostic features differ in part from those used by CLARK.

Stenometra cristata A.H. Clark, 1911

Figs 11a, 19b-c, 20a, 21, 22b, 39-41; Tables 5a-b

Stenometra cristata A.H. Clark, 1911: 553; 1912c: 210; 1918: 157.
Stenometra snelliusi A.H. Clark, 1936: 295, 313, pl. 8 fig. 9; 1950: 8, 12, pl. 1 fig. 1. — ROWE & GATES, 1995: 165.

MATERIAL EXAMINED. — **Indonesia**. KARUBAR, *Kai Islands*: stn DW 18: 1 specimen (MNHN-EcCh 57). — Stn DW 32: 1 small specimen (MNHN-EcCh 53). — *Tanimbar Islands*: stn CP 82: 10 specimens (MNHN-EcCh 55, with branch of finely pinnate primnoid alcyonarian). — Stn CP 83: 1 specimen (no registration number). — Stn CP 86: 1 specimen (MNHN-EcCh 54); 11 specimens (MNHN-EcCh 56).

REDESCRIPTION OF THE HOLOTYPE OF *S. cristata*. — (USNM 27501, Malavatuan I., Verde Is. Passage, Philippines, 13°55'55"N, 120°10'15"E, 214 m, *"Albatross"* stn 5275, 16.07.1908, 1 spec.) Centrodorsal with convex sides and strong narrow interradial ridges; basal diameter about 3.1 mm; D/H 1.1. Aboral pole conical with scattered spines and sharp papillae. Cirri in ten columns of 2-4 sockets each, separated interradially by ridge, not separated midradially. Cirri XXIV, 68, maximum length 48 mm; slender; tapered near tip; c_{1-4} short; c_5 longer, with L/W 1.2; c_6 longest, L/W 2.7. Following cirrals gradually decreasing in length; c_{20} with L/W 1.0; cirrals strongly compressed beyond proximal short few. Oral profile moderately carinate on proximal elongate cirrals; sharp projecting distal end of oral profile apparent from basal cirrals; distal margin of short basal cylindrical cirrals expanded and spinose, especially on oral side. Aboral distal margin developing sharp distally-directed projection

Source : MNHN, Paris

by c_7, increasing to long sharp distally-directed carinate spine, becoming long narrow crescentic spine on distal cirrals; spines smaller, rounded or blunt triangular on few distal cirrals of tapered tip. Opposing spine triangular or blunt, slightly larger than preceding spine. Terminal claw long or short.

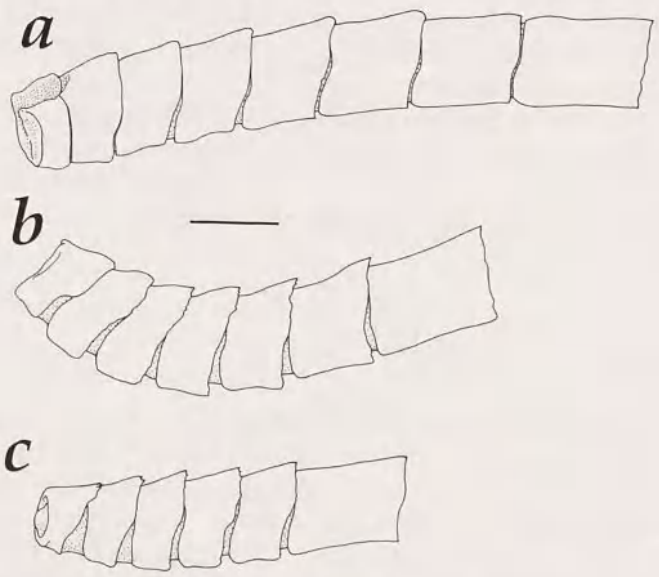

FIG. 19. — Bases of cirri: **a**, *Stenometra quinquecostata* (EcCh58) showing gradual lengthening of cirrals (KARUBAR, stn CP 86); **b-c**, *Stenometra cristata* (EcCh 56) showing abrupt lengthening between c_6 and c_7 (b) and c_5 and c_6 (c) (KARUBAR, stn DW 18). Scale bar = 1.0 mm.

Lateral margins of adjacent radials strongly raised together as continuation of interradial ridge of centrodorsal; distal corners with spine; smooth midradially.

I and IIBr2, well-separated laterally (except proximal corners of Ibr_1 in contact), strongly rounded aborally; ossicles extending laterally beyond articular ligaments. Ibr_1 shallowly V-shaped, sometimes weakly flared laterally, often with one or two strong distolateral spinelike teeth, sometimes one lateral tooth; abruptly tall narrow midaboral ridge often bidentate. Ibr_2 axil hexagonal with very short lateral margins; proximolateral margins flared, lamellate and sometimes with a few weak teeth; midaboral ridge strong, narrow, rising to triangular proximal point like an aquiline nose, and ending just distal to middle of axil. IIBr similar to IBr, but ornament generally weaker. $IIbr_1$ oblong, united interiorly; exterior lateral margin moderately flat-sided, with corners everted; interior distal corner with triangular tooth.

Arms 20, ray length 85 mm; br_1 and following brachials with narrow midaboral ridge, weakest on br_1, increasing to overlapping crescentic carina as arms become compressed distally.

P_1 and following pinnules strongly carinate. P_1 longest; following several pinnules successively decreasing in length; adambulacral lateral margin of third pinnular abruptly more widely carinate than on second pinnular.

Disk missing.

DESCRIPTION OF KARUBAR SPECIMENS. — Centrodorsal usually short, cylindrical with narrow interradial ridges; rarely domelike; rounded conical in a small specimen without interradial ridges but with narrow interradial projections; basal diameter 3.8-4.9 mm; midradial height 2.1-4.0 mm; D/H 1.1-2.1. Aboral pole flat, sometimes convex; rounded conical with two apical cirri in a small specimen.

Cirri XXV-XXXV, 76-87, maximum length 52-65 mm; long, slender and distally tapered; in ten columns, two per radial area, of two to four (rarely one to three) cirri each; columns only rarely separated by narrow space midradially; c_1 to c_{5-7} short (c_{1-4} in smaller specimens); next cirral abruptly longer than preceding, L/W 1.0-1.3; one or two following cirrals (c_{6-8}) longest, L/W usually 1.2-1.5 (extremes: 1.1-1.8); longest cirral sometimes immediately follows initial series of short cirrals. Following cirrals gradually shorter, becoming squarish (L/W ≅ 1.0) usually by c_{11-14} (extremes: c_{8-23}); cirrals slightly wider than long by or beyond mid-cirrus, very short in distal third of cirrus. Cirri strongly compressed beyond c_{3-6}, becoming sharply carinate aborally and often orally with distal ends of both aboral and (usually) oral margins sharply projecting distally by c_{7-15}; oral carination, when present, weakening and disappearing beyond longer proximal cirrals; sharp aboral distal margin gradually becoming sharp, distally-tilted triangular spine, usually crescentic on shorter distal cirrals, sometimes with distal profile dentate; spines sometimes weaker and rounded near cirrus tip. Opposing spine triangular or blunt, much larger than spines on preceding cirrals. Terminal claw gently curved, as long as or longer than penultimate cirral.

Radials short; lateral margins raised or swollen against ends of interradial centrodorsal ridges, usually with 1-2 lateral spines, tubercles or flat lamellae; aboral surface usually at right angles to oral/aboral axis of animal.

Source : MNHN, Paris

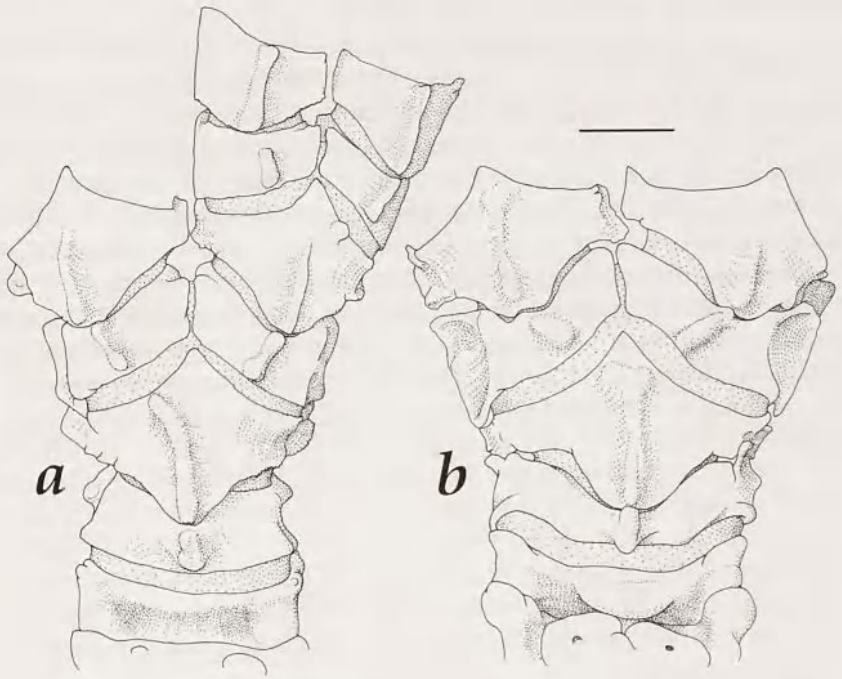

FIG. 20. — Aboral view of base of a single ray showing similar levels of ornamentation. **a**, *Stenometra cristata* (EcCh 56); **b**, *Stenometra quinquecostata* (EcCh58). Note proportionally broader, shorter IBr ossicles and midradial knob in b. Scale bar = 1.0 mm.

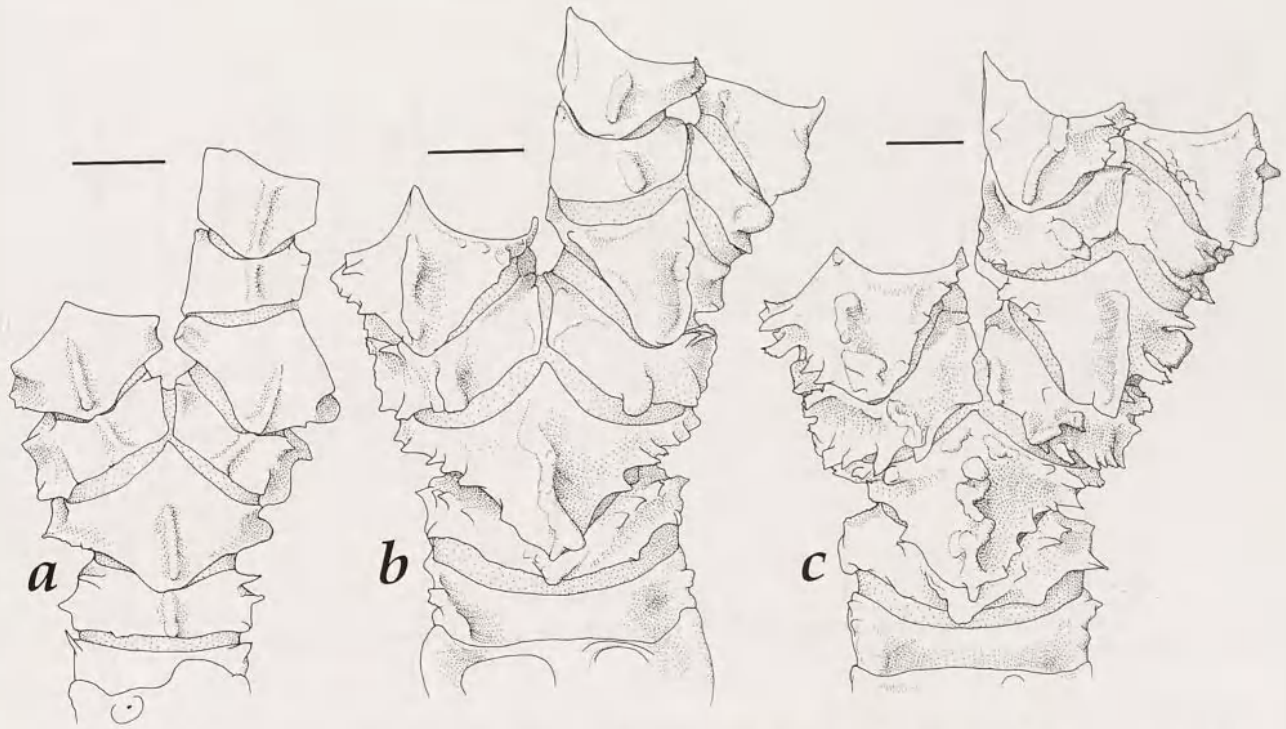

FIG. 21. — *Stenometra cristata*: aboral views of proximal portion of single rays showing increasing ornamentation from left to right. **a**, USNM 27501; **b-c**, KARUBAR, stn CP 82 (EcCh 55). Ornamentation of specimen shown in figure 20a lies between a and c of this figure. Scale bars = 1.0 mm.

Source : MNHN, Paris

Brachitaxes strongly arched, all of two ossicles each; lateral margins projecting laterally well beyond articular ligaments to form water pores; most ossicles from Ibr_2 axil to br_2 usually flat-sided, at least exteriorly. All IIBr2 usually present; IIIBr2, when present, interior or exterior; Ibr_1 united laterally, extremely short, concave distally, W/L chiefly 4.3 (extremes: 3.1-5.0); $IIbr_1$ short, almost oblong, united interiorly, W/L 2.8-4.0. I-$IIIbr_2$ axils rhombic or hexagonal with proximal synarthrial angle strongly projecting; Ibr_2 W/L 1.3-1.9 (chiefly 1.6-1.7); $IIbr_2$ W/L 1.4-1.7. I-$IIIbr_1$ and br_1 with midaboral spine, tubercle or ridge, the latter sometimes irregular or dentate (Ibr_1 with up to three spines). I-$IIIbr_2$ axils with midaboral ridge usually either smooth or dentate, often rising to proximal tooth, sometimes twisted distally, rarely irregularly convoluted or composed of two or three tall coalescing knobs. Proximo- and distolateral margins of brachitaxes ossicles everted or not, usually with one to a few, often strong, spines or teeth; proximolateral margins of Ibr_1 and distolateral margins of axils more often smooth; proximolateral margins of axils sometimes flared and lamellate as well as dentate; distolateral corners of I-$IIIbr_1$ and br_1 (interiorly on II-$IIIbr_1$ and br_1) with one to few spines. Ornamentation generally weaker on more distal brachitaxes. One specimen with crowded aboral spines on Ibr_2 axil (except midaborally).

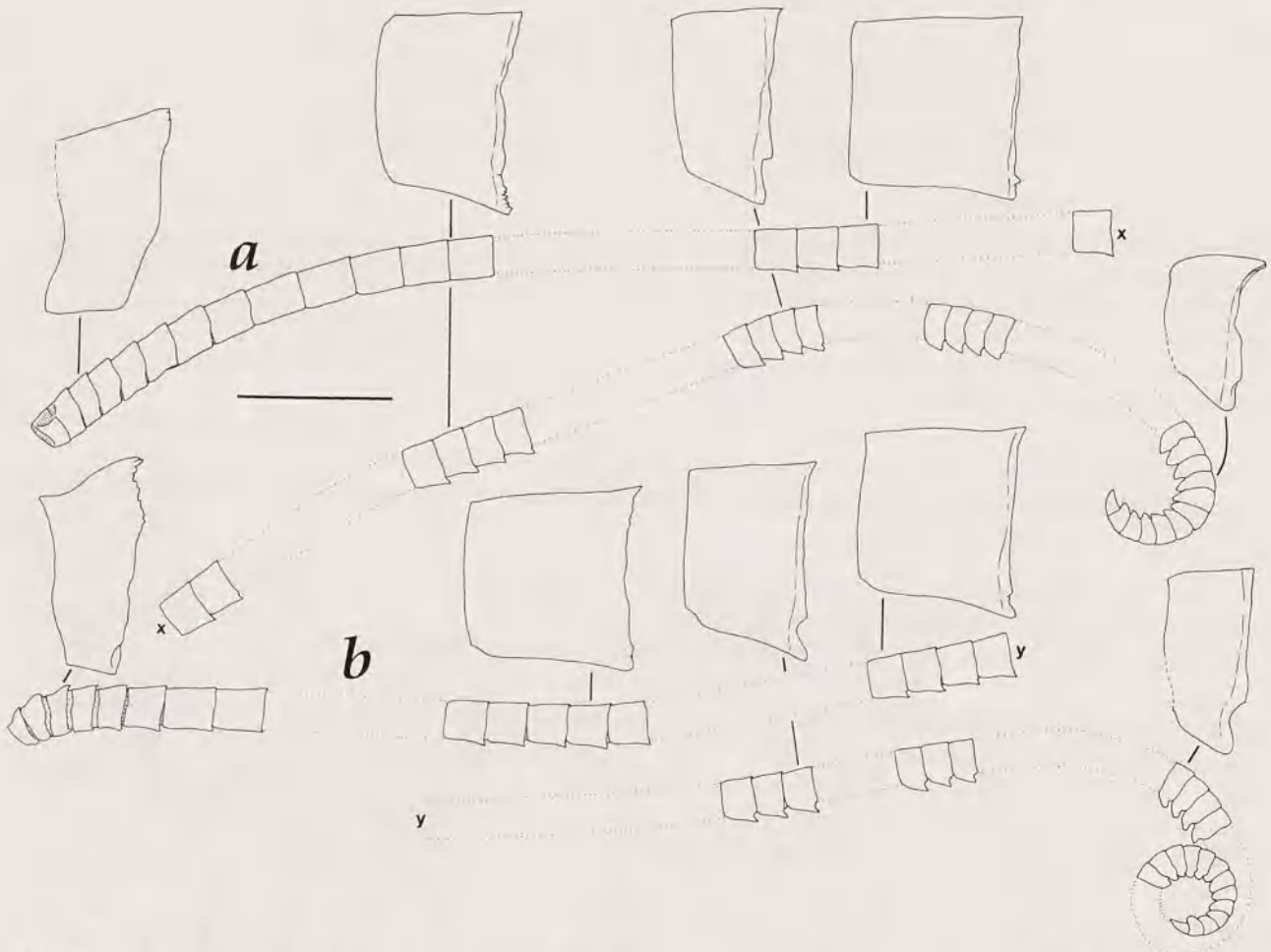

FIG. 22. — Cirri: **a**, *Stenometra quinquecostata* (EcCh58) (interrupted at x); **b**, *Stenometra cristata* (EcCh56) (interrupted at y). Scale bar: a, b = 4.0 mm; enlarged cirrals = 1.0 mm.

Arms 16-26 (20 in nine of 14 specimens); ray length up to 95 mm, but arms usually incomplete; br_1 slightly longer exteriorly, W/L 2.1-2.7; br_2 larger, projecting proximally, W/L 1.4-1.7; br_{3+4} W/L 1.1-1.5, diameter 1.5-1.7 mm (chiefly 1.7 mm). Ornamentation of brr_{1-2} similar to that of brachitaxes, but usually weaker; eversion, spines and teeth sometimes absent; ossicles sometimes flat-sided to br_3 exteriorly, br_2 interiorly; br_5 to about br_{10}

Source : MNHN, Paris

short, oblong, W/L 1.8-2.1. Following brachials short and cuneate, W/L 1.4-2.1; distal brachials strongly compressed and almost oblong, W/L 1.1-1.6 (chiefly 1.4). Midaboral ridge becoming a sharp, distally curved, carinate crest overlapping next brachial by middle of arm; sometimes offset on successive brachials or curved so that successive crests form a sinuous carination; crests long and crescentic with finely spinose distal margin on distal brachials; weaker on distal brachials in a few specimens.

Pinnules strongly carinate; smooth except for small spine at distal corners of pinnulars; abambulacral carina on proximal segments of P_1 sometimes weakly dentate. P_1 of up to 17 segments, 13.7 mm long (usually 13-15 segments, 8-11 mm). P_2 shorter and slenderer, up to 15 segments, 10.9 mm. Following pinnules progressively shorter to P_{5-6} (sometimes P_7 or P_8 about equally short) of 7-9 segments, 4.0-6.1 mm. Pinnules subsequently increasingly in length; middle pinnules of 12-13 segments, 5.4-7.5 mm. Distal pinnules of 13-15 segments, 6.7-7.6 mm long.

Disk naked.

DESCRIPTION OF A SMALL SPECIMEN (EcCh 53). — This specimen differs from the preceding as follows: centrodorsal a pentagonal cylinder, diameter 2.8 mm; aboral pole flat and papillose; interradial ridges sometimes with one or two spines near base of centrodorsal. Proximal cirrals with strongly projecting, sharp distal oral margins, but increasing in length more gradually than preceding specimens; c_{1-3} short; c_4 with L/W 0.9; c_5 with L/W 1.2; c_6 longest, with L/W 1.4. Aboral distal margin of c_1 sometimes strongly dentate. Brachitaxis ornamentation similar to that of preceding specimens; e.g., midaboral ridges mostly smooth, like an aquiline nose on some axils, reduced to spine on Ibr_1; axils with proximolateral margins flared and dentate. Arms 20, all broken at bases.

DISTRIBUTION. — From Luzon, Philippines, through eastern Indonesia to Port Hedland, northwestern Australia, in about 200 to 285 m (possibly 170-297 m), based on the type specimens of *S. cristata* and *S. snelliusi* (A.H. CLARK, 1931), additional material identified as *S. snelliusi* (ROWE & GATES, 1995), and the KARUBAR collection.

REMARKS. — See remarks following *Stenometra quinquecostata* (Carpenter), below.

Sp.	Sta.	Centrodorsal			Cirri			P_1		P_2		P_{short}		P_{mid}		P_{dist}	
		Diam. Base	Height	D/H	No. Cirri	Max. L	No. Segs.	L	No. Segs.	L	No. Segs.	L	No. Segs.	L	No. Segs.	L	No. Segs.
1	18	4.9	2.4	2.1	25	65	87	11.9	17	~8.4	12	4.3	8	5.4	12	7.0	14
2	86	4.1	3.2	1.3	27	55	82	13.7	17			4.4	8			7.6	15
3	86	4.1	2.7	1.5	28	52	76	8.0	12	7.9	11	6.1	7	6.2	13	7.3	13
4	86	3.8	2.1	1.8	30	55	77	9.5	13	7.9	11	4.0	7	7.5	15	6.7	13
5	86	4.6	3.2	1.5	35	64	83	9.5	13								
6	86	4.3	4.0	1.1	29	~60	79										
7	82	4.4	3.0	1.5	34	52	84	10.3	14	10.9	15	5.0	9	6.6	14	7.6	14
8	82	4.1	2.7	1.5	26	54	87	8.3	14								
9	82	4.0	2.9	1.4	31	52	81	10.3	15								
10	82	4.4	3.3	1.3	32			11.1	15								
11	82	4.4	2.9	1.6	34	61	84										
12	82	4.4	3.0	1.5	31	60	84	11.0	16								
n		12	12	12	12	11	11	10	10								
$\overline{X}$		4.3	3.0	1.5	30	57	82	10	15								
s		0.3	0.5	0.3	3.3	5.1	3.7	1.7	1.7								

TABLE 5a. — *Stenometra cristata*; measurements and statistics for 16 traits (max. n = 12). Abbreviations: P_{short}, one of the short pinnules from P_3 to P_6; P_{mid}, middle pinnule; P_{dist}, distal pinnule. Other abbreviations as in Table 2a.

Source : MNHN, Paris

Sp.	Sta.	Rays												
		Arm No.	Ray L	Ibr_1 W/L	Ibr_2 W/L	$IIbr_1$ W/L	$IIbr_2$ W/L	br_1 W/L	br_2 W/L	br_{3+4} W/L	br_{3+4} diam.	brr_{5-11} W/L	br_{mid} W/L	br_{dist} W/L
1	18	20	~65	4.3	1.7	3.6	1.7	2.5	1.6	1.3	1.7	2.0	2.0	1.6
2	86	20		4.3	1.3	2.8	1.5	2.1	1.5		1.7	1.8	1.7	1.5
3	86	20	~90	3.1	1.8	2.9	1.5	2.1	1.4	1.5	1.7	2.0	1.6	1.4
4	86	20	95	3.1	1.7	2.8	1.4	2.3	1.6	1.3	1.7	1.9	1.5	1.4
5	86	21		3.3	1.6	4.0	1.4	2.2	1.7		1.7		1.8	
6	86	20									1.6			
7	82	23	70	5.0	1.7	3.1	1.4	2.7	1.5	1.1	1.7	2.1	1.6	
8	82	26-27	65	4.3	1.9	2.8	1.7	2.3	1.7	1.4	1.6	2.0	1.4	
9	82	20				3.6	1.4	2.2	1.4		1.5			
10	82	20-21			1.6	2.9	1.6	2.1	1.4		1.7			
11	82	20			1.6	3.6	1.5	2.7	1.4	1.2	1.7	2.0-2.5	2.1	1.4
12	82	20	90								1.7		1.4	1.1
n		12	6	7	9	10	10	10	10	6	12	7	9	6
$\bar{X}$		20	80	3.9	1.7	3.2	1.5	2.3	1.5	1.3	1.7		1.7	1.4
s		1.0	13.2	0.7	0.2	0.4	0.1	0.2	0.1	0.1	0.1		0.2	0.2

TABLE 5b. — *Stenometra cristata*; measurements and statistics for 13 traits (max. n = 12). Abbreviations: brr_{5-11}, brachials five through 11; br_{mid}, middle brachial; br_{dist}, distal brachial. Other abbreviations as in Table 2b and 4b.

Stenometra quinquecostata (Carpenter, 1888)

Figs 19a, 20b, 22a

Antedon quinquecostata Carpenter, 1888: 215, pl. 3 figs 6a-d, pl. 38 figs 1-3.
Thalassometra quinquecostata - A.H. CLARK 1907: 360.
Stenometra quinquecostata - A.H. CLARK, 1909a: 15; 1911: 554; 1950: 8, 13, pl. 1 figs 2-3, pl. 2 figs 4, 6-7.

MATERIAL EXAMINED. — **Indonesia**. KARUBAR, *Kai Islands*: stn DW 18: 4 specimens (MNHN-EcCh 58).

DESCRIPTION. — Centrodorsal a short, pentagonal cylinder, with short, swollen interradial projections, sometimes with low interradial ridges in aboral half; basal diameter 3.8-4.1 mm; midradial height 2.9-3.2 mm; D/H 1.2-1.4. Pole flat or concave, with a raised margin of ridges, tubercles or aboral margins of large apical cirrus sockets. Centrodorsal in one specimen with converging sides and irregular, domelike apex.

Cirri XXVI-XXVII, 80-88, 60-65 mm; extremely slender, distally tapered; in ten crowded columns of three or four cirri each; columns not separated midradially, sometimes slightly separated interradially (especially peripheral sockets) by narrow interradial ridges; c_1 to c_{5-7} short, increasing gradually in length to longest; c_6, c_7 or c_8 squarish; one or two cirrals from c_8 to c_{10} longest, L/W 1.3-1.6. Cirrals following longest gradually decreasing in length; as long as wide by c_{14}; strongly compressed beyond short proximal cirrals; oral margin weakly carinate if at all, projecting distally on short proximal cirrals (again only weakly beyond about c_{23} in one specimen); aboral margin carinate by c_{10}, developing sharp distal projection between c_{15-23} which gradually develops into sharp, triangular, distally-directed spine; spines with convex proximal profile only on very short distal cirrals; never high and crescentic. Opposing spine triangular, slightly or distinctly larger than preceding spines. Terminal claw gently curved, slightly longer than preceding cirral.

Adjacent radials with lateral margins either strongly raised together as a continuation of interradial centrodorsal ridge or swollen together around and distal to short interradial process of centrodorsal; with midradial swelling or spine.

All brachitaxes of two ossicles; one specimen with one IIBr bearing two IIIBr2, and four IIBr each bearing one exterior IIIBr. Ossicles convex aborally but not strongly arched, with lateral margins flattened and apposed (except

Source : MNHN, Paris

in one specimen), extending laterally beyond ligaments (although water pores very weak and narrow); low narrow midaboral ridge on all brachitaxes ossicles and proximal brachials (very weak on IIBr series in two specimens). Ibr_1 united laterally, shallow U- or V-shaped with lateral margins sometimes weakly everted and with one or two flat triangular teeth at distolateral corners, W/L 4.0-4.5. Ibr_2 axil hexagonal or almost rhombic with strong proximal synarthrial swelling; short lateral margins flat and weakly everted; midaboral ridge sometimes wider or forked distally, sometimes not reaching distal margin of ossicle, W/L 1.4-1.8. $IIbr_1$ shallowly V-shaped, longer and thickened exteriorly, with distal portion of lateral margin and lateral portion of distal margin everted aborally, sometimes forming a sharply raised wall at distolateral corner of ossicle enclosing a concave pocket, W/L 2.7-2.9; aboral ridges oriented diagonally, connecting ends of ridges on I and $IIbr_2$ axils. $IIbr_2$ axil hexagonal with thickened lateral margins and weak midaboral ridge, W/L 1.4-1.5.

Arms 19-25; all rays broken; brr_{1-2} similar to $IIbrr_{1-2}$, but weakly flat-sided and laterally everted, if at all; aboral ridges weak; br_1 longer exteriorly, with a flat triangular tooth at the interior distal corner, W/L 2.0-2.3; br_2 larger, projecting proximally, W/L 1.3-1.5; br_{3+4} diameter 1.6 mm, W/L 1.2-1.4; brr_{5-9} oblong, W/L 1.8-2.0. Brachials cuneate by br_{15}, W/L 1.7-2.0; distal brachials compressed. Aboral ridge very weak on proximal brachials, but increasing as overlapping crescentic carina on compressed distal brr.

Syzygies at br_{3+4} (one br_{1+2}), br_{20+21} to br_{31+32}; next two intervals seven to ten; distal intervals three to ten (chiefly three to six).

P_1 of 12-18 segments, 9-13 mm long, sometimes flattened proximally; sometimes with middle pinnulars carinate; subcylindrical distally. Following pinnules shorter and becoming strongly carinate as in *S. cristata*.

Disk naked.

DISTRIBUTION. — Known definitely only from the Kai Islands in 212-256 m. It is not certain whether other specimens identified as *S. quinquecostata* by A.H. CLARK (1950) from Sulawesi, Ternate and Timor (all eastern Indonesia) represent this species or *S. cristata*.

REMARKS. — We have resurrected *S. cristata* from synonymy with *S. quinquecostata* for two reasons. Re-examination of the type of *S. cristata* (described above) indicates that it is conspecific with one of the two species of *Stenometra* collected by the KARUBAR expedition. Secondly, the other, clearly distinct, Karubar *Stenometra* most closely approaches the written description of the type of *S. quinquecostata* (CARPENTER, 1888; A.H. CLARK, 1950).

In specimens distinguished as *S. cristata*, the oral margins of the cirri are more sharply carinate and projecting, and the cirrals following the short basal cirrals are abruptly longer. Brachitaxis ossicles are strongly arched aborally with proximo- or distolateral margins dentate, spinose, flared, or lamellate (or a combination), and they have strong, often ornamented midaboral ridges. In those distinguished as *S. quinquecostata,* the oral carination on the cirri (except on a few proximal segments) is absent, and the proximal cirrals gradually increase in length. Brachitaxis ossicles are convex aborally but not strongly arched, their lateral margins are strongly flattened and apposed, their proximo- and distolateral margins are never ornamented as in *S. cristata*, and they have low midaboral ridges.

The KARUBAR specimens assigned to *S. cristata* span a wide range of ornamentation that appears to include *S. snelliusi* as well, yet certainly represents a single taxon. We thus tentatively synonymize these two species, pending comparison with the type of *S. snelliusi*. Similarly, identification of the latter species as *S. quinquecostata* must remain tentative pending comparison with that type material. *Stenometra diplax* A.H. Clark, a synonym of *S. quinquecostata* according to A.H. CLARK (1950), is not included in the synonymy of either KARUBAR species pending examination of the type material.

Genus ***STIREMETRA*** A.H. Clark, 1909a

REMARKS. — A.H. CLARK (1950) distinguished *Aglaometra* from *Stiremetra* on the basis of the former's larger size and more broadly rounded proximal postradial ossicles. He may be correct in distinguishing them, but not entirely for the reasons given. Most included species of *Stiremetra* are known from one or few badly

Source : MNHN, Paris

damaged specimens, the damage usually involving complete loss of arms beyond their bases. Despite this loss, A.H. CLARK (1950) placed *Stiremetra* (with *Aglaometra*) in the group of thalassometrids with arms rounded to their tips and never carinate. This does appear to be the case in *S. carnifera* A.H. Clark (A.M. CLARK, 1967), *S. acutiradia* (Carpenter) (A.H. CLARK, 1950), and *S. lusitanica* (Carpenter) (KOEHLER, 1909) although A.M. CLARK (1980) has removed the latter to *Thalassometra*. [NOTE: She mentioned, incorrectly, that the other species of *Stiremetra* "are said to have cirri in fifteen columns" (A.M. CLARK, 1980: 192)]. A.H. CLARK (1950) describes them as having ten columns with the possible exception of *S. acutiradia* which he diagnoses as having ten columns, but notes that CARPENTER's (1888) original figure appears to have the cirri in "a single rather crowded marginal row" (A.H. CLARK, 1950: 132)]. However, in *S. breviradia* (Carpenter) and *S. spinicirra* (Carpenter), the distal brachials have the long, carinate, overlapping spines characteristic of A.H. CLARK's first group of genera (CARPENTER, 1888; A.H. CLARK, 1950). Descriptions of *S. breviradia* also note that the distal brachials are compressed. These latter two are thus not easily identifiable using A.H. CLARK's key. All known specimens of the remaining species, *S. perplexa* (A.H. Clark) and *S. decora* A.H. Clark, lack distal arms.

All species in the genus appear to be united by similar P_1, which, with its greatly broadened proximal portions, is much larger and stouter than the following pinnules. On this basis, they do fall into the group with arms rounded to their tips, which A.H. CLARK (1950: 6) additionally characterized as having P_1 "much enlarged, very stout and much broadened basally". However, in many specimens of both *Aglaometra* and *Oceanometra*, which also supposedly belong to this group of genera, the pinnules gradually decrease in size and robustness from P_1 (or P_{II}).

Stiremetra breviradia (Carpenter, 1888)

Antedon breviradia Carpenter, 1888: 110, pl. 3 figs 4a-c, 5a-c, pl. 11 fig. 5, pl. 19 figs 1-4, pl. 20 figs 1-2.
Stiremetra breviradia - A.H. CLARK, 1909a: 15; 1915: 365, figs 486-487; 1921, pl. 2 figs 975-978, pl. 44 fig. 1301; 1950: 120, 126.

MATERIAL EXAMINED. — **Indonesia**. KARUBAR: *Kai Islands*: stn CP 20: 1 specimen (MNHN-EcCh 47).

DESCRIPTION. — Centrodorsal conical with tall, knoblike apex; margin not concave midradially; interradial extensions absent; basal diameter 1.9 mm; height 1.9 mm. Cirrus sockets in ten columns of two or three sockets each, almost covering centrodorsal; basal sockets separated slightly midradially by very small triangular area; apical sockets crowded. Cirri XXVII, 33, 22 mm; tapered near tip; c_{1-3} short; c_4 squarish; c_5 to at least c_{14} longer than wide; c_5 transitional and longest, L/W 1.8; cirrals remaining about as long as wide to mid-cirrus. Sharp, distally-directed aboral spine first appearing on c_8, gradually increasing in size; becoming hooked on short distal cirrals; narrowly triangular in cross section. Some middle cirrals with distinct aboral hump proximal to spine apex; spine smaller but still sharp and hooked on distal few cirrals. On a few cirri, aboral processes low and rounded, not spinelike, with fine spinules on distal cirrals. Opposing spine tall, triangular and sharp on cirri with spines; low and rounded on cirri with low rounded processes. Terminal claw longer than preceding cirral.

Radials well exposed with thick, high squarish midaboral ridge, highest proximally; distal margins projecting distally beyond articulation. Brachitaxes arched aborally with low rounded midaboral ridge; small water pores present between adjacent IBr2 and interiorly between adjacent brr_{1-2}. Ibr_1 very shallowly U-shaped, laterally thickened; sometimes with one or two distolateral spines, W/L 2.9; Ibr_2 axil hexagonal with lateral margins slightly thickened and apposed but not distinctly flat-sided; no spines or other ornament, W/L 1.4.

Arms 10; ray length 72 mm; br_1 longer exteriorly, sometimes with weak exterior distolateral spine, W/L 1.8; br_2 larger, W/L 1.6; brr_{1-2} sometimes with trace of midaboral ridge; brr_{2-3} sometimes weakly flat-sided and apposed; br_{3+4} squarish, 1.7 mm across; brr_{5-6} oblong, W/L 1.6; br_9 or br_{10} to about br_{15} triangular, W/L 1.8. Following brachials becoming strongly cuneate and compressed, W/L 1.4; distal brachials strongly compressed, shorter and weakly cuneate, W/L 1.2. Brachials beyond proximal third of arm developing a strongly raised, overlapping, at least slightly curved (sometimes triangular in profile) midaboral carina; sometimes spinulose; weaker near arm tip. Syzygies at br_{3+4}, br_{13+14} to br_{14+15}; distal interval chiefly five or six (up to nine).

Source : MNHN, Paris

P_1 and P_a much larger, stouter and basally broader than following pinnules; slightly flattened basally where adjacent rays are apposed; basal segments with smoothly rounded flanges. P_1 12 segments, 5.4 mm. Following several pinnules short, small, carinate, lacking flanges and with weak distal spines on all segments except proximal few. P_2 8 segments, 3.0 mm. P_3 thinner, 9 segments, 3.0 mm. P_4 similar, 8 segments, 2.6 mm. Following pinnules more robust and increasing gradually in length. Middle pinnules of up to 12 segments, 7.6 mm. Distal pinnules of up to 14 segments, 10.0 mm. Middle and distal pinnules with all segments carinate (except basal two) and longer than wide (except basal two and few near tips).

DISTRIBUTION. — Known previously from Fiji and the Kermadec Islands in 1152-2285 m (A.H. CLARK, 1950). The KARUBAR specimens extend the range to eastern Indonesia in shallower water: 769-809 m.

REMARKS. — The KARUBAR specimen differs from CARPENTER's (1888) and A.H. CLARK's (1950) descriptions of the original *"Challenger"* specimens only in minor respects as follows: in the latter, the aboral pole bears papillae, there are fewer (XV-XX) cirri, and the radials are scarcely visible. However, CARPENTER's figure of a smaller specimen bearing a myzostome cyst (1888, pl. 19 fig. 2) clearly shows the radial bearing an obvious midaboral ridge as in the KARUBAR specimen. The rays in the KARUBAR specimen are close together so that the disk cannot be examined without damaging the specimen.

BIOGEOGRAPHY

The KARUBAR Expedition collected comatulids at seventeen stations over a depth range of 82 to at most 850 m. Ten stations fell between about 200 and 400 m. The collection represents a substantially smaller effort that covered a smaller area and depth range than the previous major expeditions to the area. Yet, the collection is surprisingly rich. The KARUBAR Expedition collected 22% of the 67 nominal checklist species (omitting the unidentified families Charitometridae and Antedonidae) known from the outer shelf to the upper bathyal zone of the East Indian archipelago (100 to 1000 m).

	Expedition						
Species	*Albatross*	*Challenger*	Mortensen	*Investigator*	*Siboga*	Other	Karubar
Aphanocomaster pulcher	-	-	-	-	1	-	19
Palaeocomatella difficilis	-	1	-	-	1	-	1
Palaeocomatella hiwia	-	-	-	-	-	10	4
Asterometra longicirra	1	-	-	-	1	-	1
Neometra alecto	20	-	-	-	1	5	2
Neometra xenocladia	-	-	-	-	-	-	8
Aglaometra valida	5	3	-	-	9+?	4	28
Cosmiometra iole	-	-	2	-	-	-	4
Cosmiometra philippinensis	4	-	4	-	3	8	26
Crotalometra rustica	1	-	-	1	2	2	2
Oceanometra annandalei	15	-	3	3+?	1	1	40
Stenometra cristata	7	-	-	-	-	1	25
Stenometra quinquecostata	1	3	-	-	-	22+?	4
Stiremetra breviradia	-	4	-	-	-	-	1

TABLE 6. — Numbers of specimens of comatulids (identified to species) collected by the KARUBAR and previous expeditions. Data are from A.H. CLARK (1931, 1947, 1950). A plus sign and question mark (+?) indicate that additional specimens exist but that the published references to museum holdings omit the number of specimens. ROWE and GATES (1995) record additional specimens of *Crotalometra rustica* and *Stenometra snelliusi* from western Australia (Western Australian Museum), but do not specify numbers of specimens.

Source : MNHN, Paris

No single earlier expedition collected all 15 species identified herein (Table 6). It is thus not surprising that the KARUBAR material includes several geographical and bathymetric range extensions. Three species (*Palaeocomatella hiwia*, *Stiremetra breviradia* and *Cosmiometra iole*) are recorded from Indonesian waters for the first time (Figs 23-24). (*Stenometra cristata* was reported previously from this area as *S. snelliusi*). Two of these represent substantial range extensions. *S. breviradia* was previously dredged off Fiji and the Kermadec Islands (A.H. CLARK, 1950). *P. hiwia* was previously restricted to New Zealand waters (MCKNIGHT, 1977). By contrast, two species, *Aphanocomaster pulcher* and *Asterometra longicirra*, remain endemic to the Kai Islands (although the latter may be synonymous with other more widely distributed *Asterometra* species). *Neometra xenocladia* is also endemic, but is described here as a new species (Fig. 25).

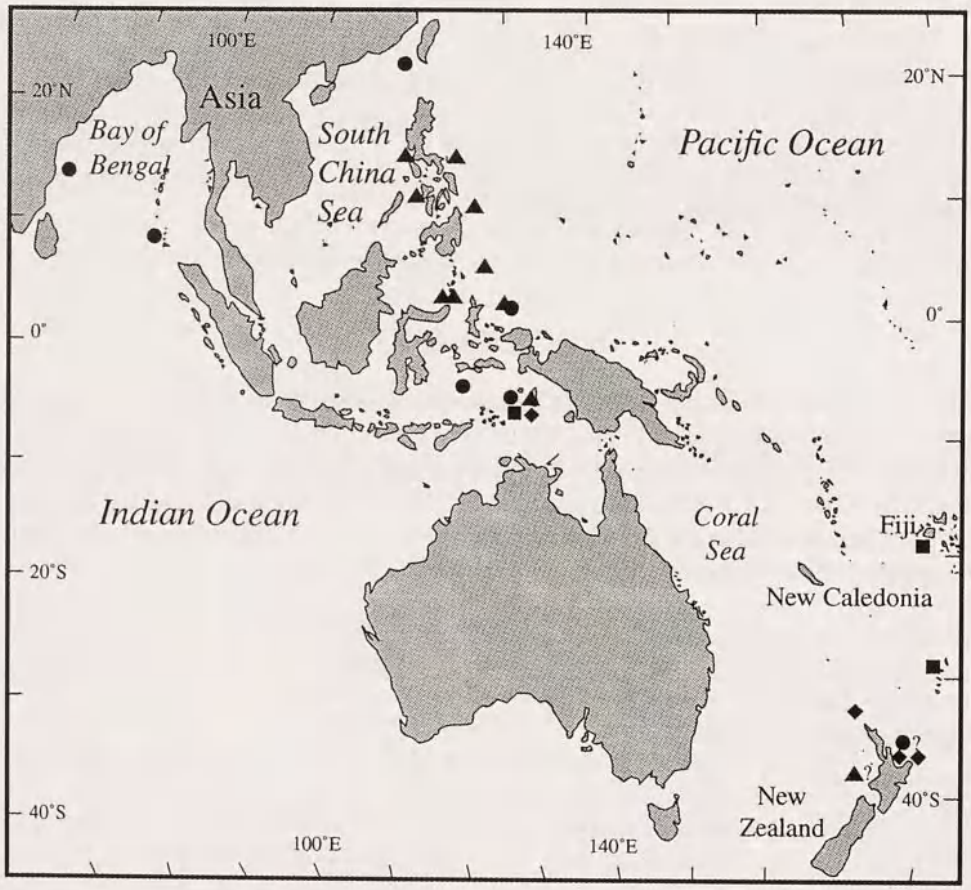

FIG. 23. — Distribution of identified KARUBAR comatulids: species with broad geographic ranges. ●, *Crotalometra rustica*; ◆, *Palaeocomatella hiwia*; ■, *Stiremetra breviradia*; ▲, *Aglaometra valida*. New Zealand records of *C. rustica* and *Aglaometra valida* [called *C. rusticata* and *A. incerta*, respectively, by MCKNIGHT (1977)] are questionable.

The KARUBAR material extends the depth ranges of *Stiremetra breviradia*, *Cosmiometra iole*, *Palaeocomatella hiwia* and *P. difficilis* into shallower water and that of *Aphanocomaster pulcher* into considerably deeper water (Fig. 26). For the latter, a considerable gap exists between the original record ("Down to 52 Metres." A.H. CLARK, 1918: 275) and the KARUBAR material (confirmed 299-390 m; possible 296-502 m). The possibility exists that morphological differences between the two collections might be depth-related, as suggested for stalked crinoids (BOURSEAU & ROUX, 1989; AMÉZIANE-COMINARDI, 1991). However, one must treat older bathymetric data with caution. Earlier expeditions generally recorded the depth at each station via a single lead-line sounding. The technique took no account of local variations in sea-floor topography, which are often substantial along insular margins where much of this sampling took place.

Source : MNHN, Paris

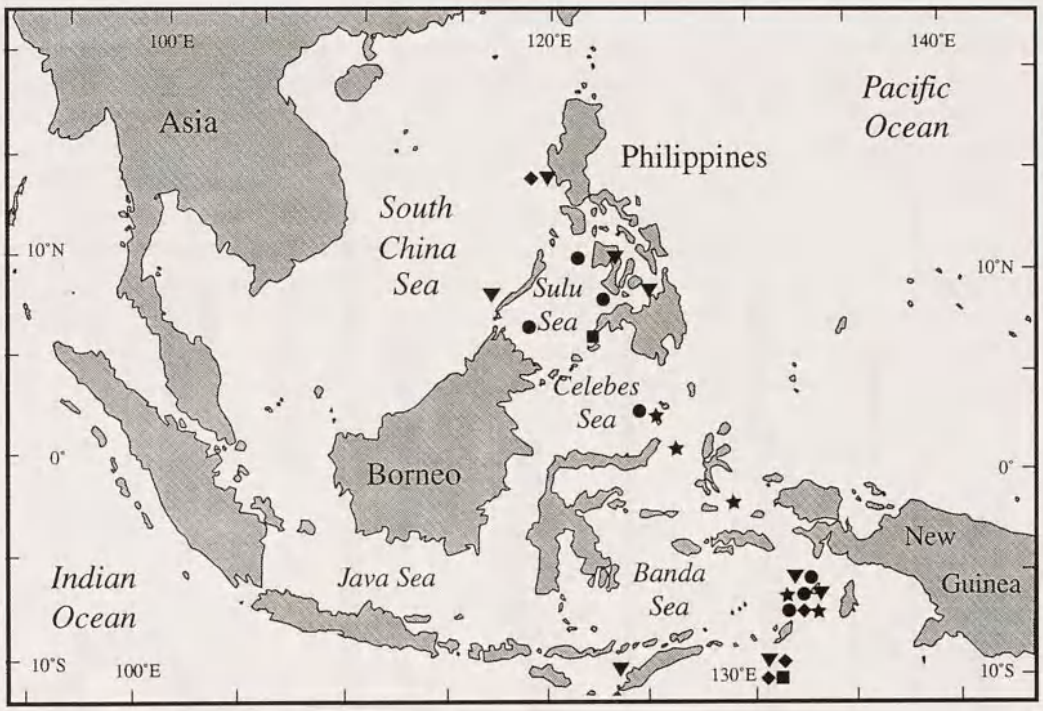

FIG. 24. — Distribution of identified KARUBAR comatulids: Thalassometridae with known ranges restricted to the East Indian archipelago. ●, *Cosmiometra philippinensis*; ■, *Cosmiometra iole*; ▼, *Oceanometra annandalei*; ★, *Stenometra quinquecostata*; ◆, *Stenometra cristata*.

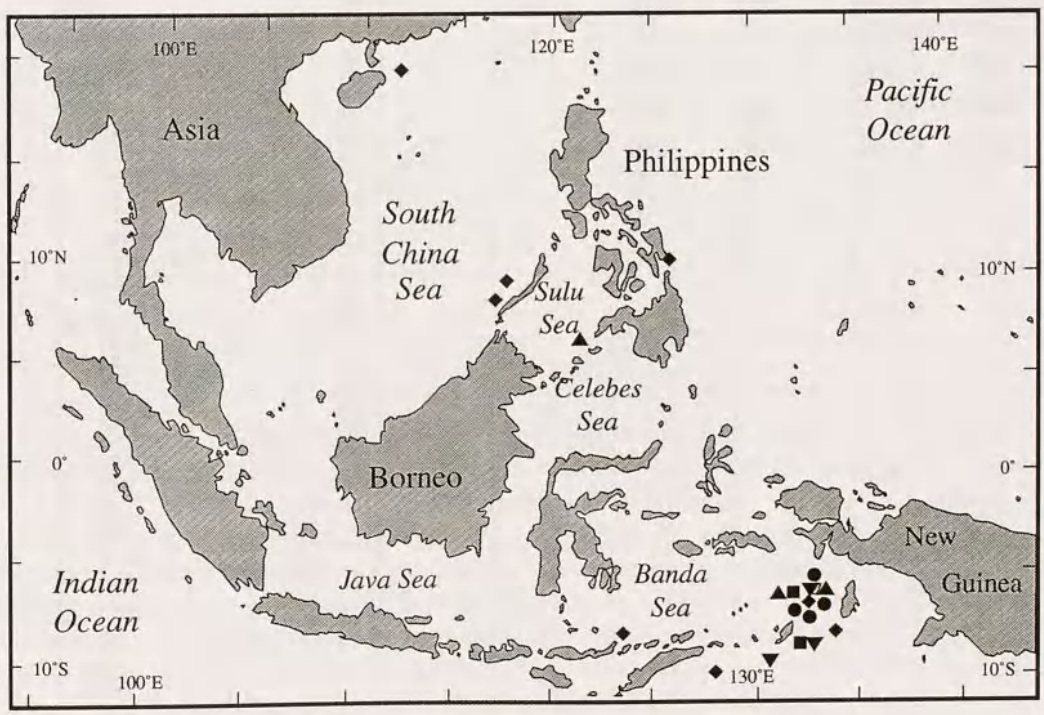

FIG. 25. — Distribution of identified KARUBAR comatulids: Comasteridae, Asterometridae and Calometridae with known ranges restricted to the East Indian archipelago. ●, *Aphanocomaster pulcher*; ▲, *Palaeocomatella difficilis*; ◆, *Neometra* cf. *alecto*; ▼, *Neometra xenocladia*; ■, *Asterometra longicirra*.

Source : MNHN, Paris

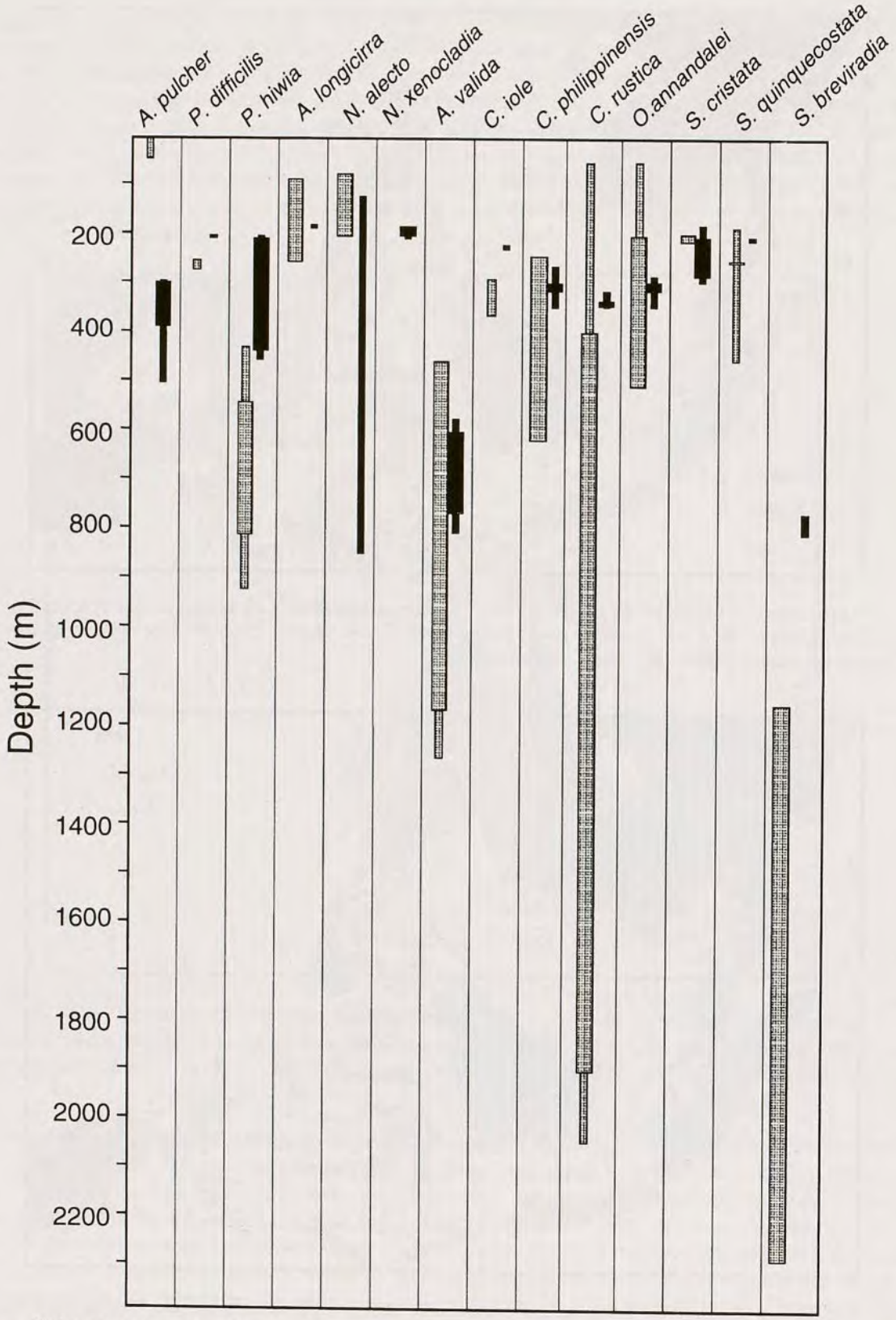

FIG. 26. — Bathymetrical ranges of comatulid species collected by the KARUBAR Expedition (black bars) relative to previous depth ranges (stippled bars). Narrower bars represent possible depth ranges.

Source : MNHN, Paris

Eight of the 15 identified species are thalassometrids. Four of these, *Aglaometra valida*, *Oceanometra annandalei*, *Cosmiometra philippinensis* and *Stenometra cristata*, together account for 75% of identified specimens. This dominance reflects an important aspect of comatulid biogeography. The East Indian archipelago supports the richest comatulid fauna in the world. About one hundred nominal species live in shallow-water (<50 m) (MESSING, 1994, 1998a). The checklist above cites a similar number (108 species including charitometrids and antedonids) in 100-1000 m. Together, these faunas account for almost 40% of known comatulid species. Although most families found in the region have representatives in both shallow and deeper water, the two depth ranges support substantially different assemblages. Comasterids, himerometrids, colobometrids and mariametrids dominate the shallow-water fauna while thalassometrids, charitometrids and antedonids account for over fifty percent of the deeper species (Fig. 27). Similarly, the same three latter families account for the great majority of KARUBAR specimens. Of the 108 deeper-water species, only eleven occur in <50 m. Maximum richness occurs in 100-299 m and gradually diminishes with increasing depth (Fig. 28), although this pattern may reflect collecting effort, at least in part.

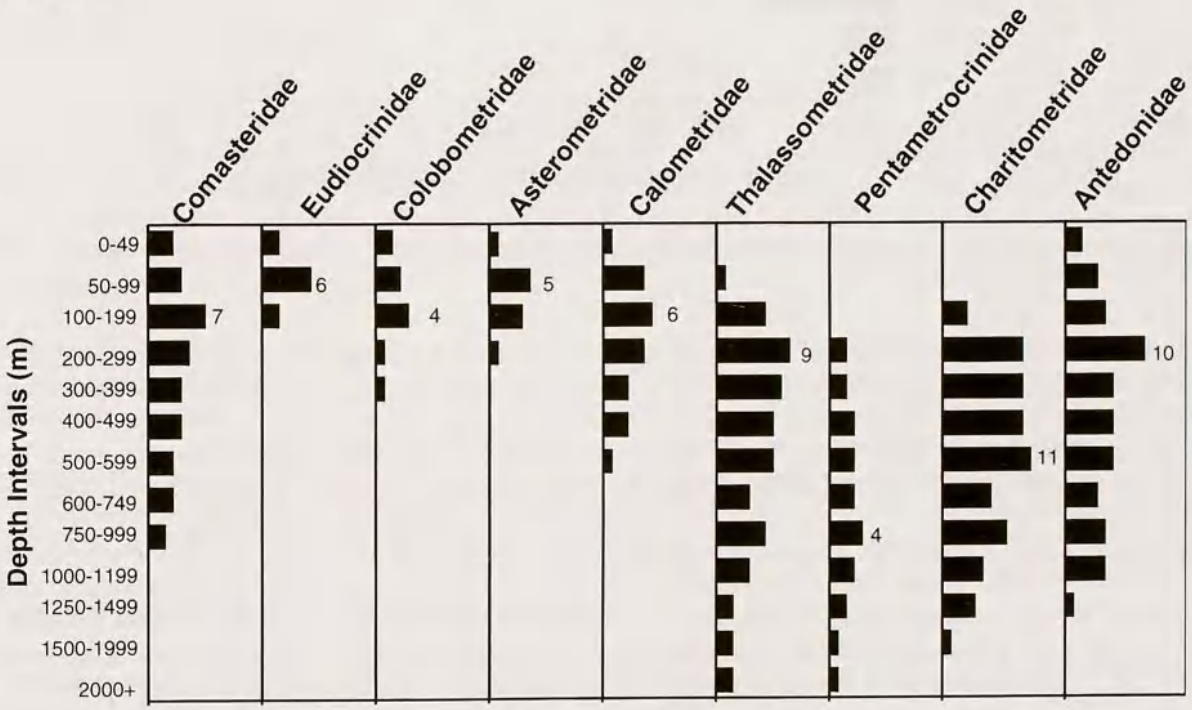

FIG. 27. — Bathymetric distribution of comatulid species by family occurring between about 100 and 1000 m: numbers of species plotted by depth interval (meters). The number of species in the richest depth interval is given for each family.

The KARUBAR material reminds us how little we still know about tropical Indo-Western Pacific crinoid distributions. The collection adds five species to the deeper-water comatulid fauna of the Kai Islands, bringing the total to 37, that is, 55% of the East Indian deeper-water fauna (again, exclusive of the antedonids and charitometrids; see the checklist). It remains unclear, however, how much additional collecting will add to the fauna. Several species known from nearby island groups are certainly strong candidates [e.g., *Thalassometra hirsuta* A.H. Clark and *Cosmiometra woodmasoni* (Bell) from off Timor]. Also, a tendency supposedly exists for taxa with broad bathymetric distributions (e.g., many thalassometrids) to have wider geographic ranges (A.H. CLARK, 1914; GISLÉN, 1951). However, MESSING (1998a: 187) reported that, for the better known shallow-water comatulid fauna, "local areas within the East Indian archipelago appear to support no more than about half the total number recorded". Certainly such faunal variations derive at least in part from insufficient collecting, especially for deep-water habitats. Yet, the various isolated basins within the archipelago (e.g., Celebes, Sulu, Savu and Aru) may possibly support substantial endemism.

Source : MNHN, Paris

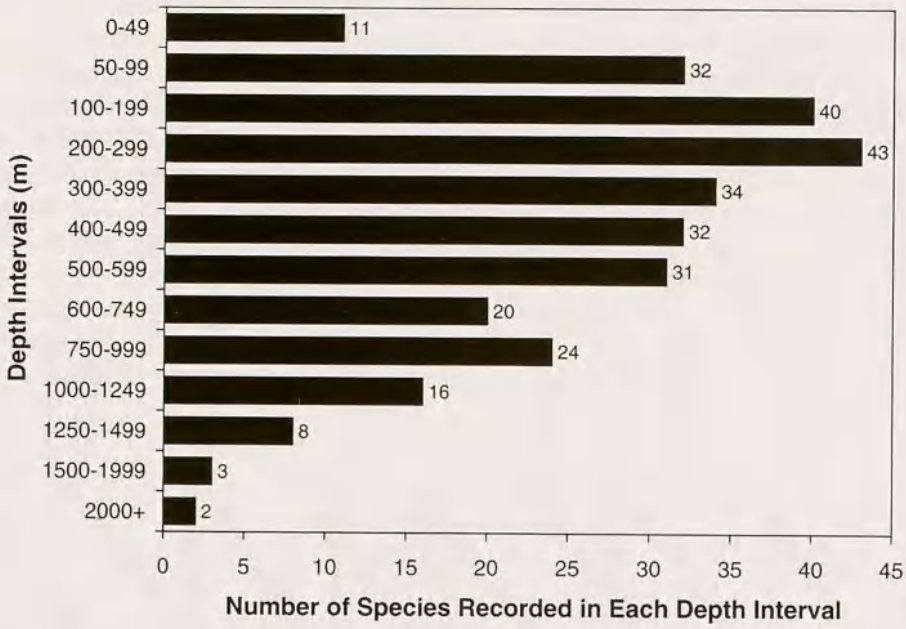

FIG. 28. — Bathymetric distribution of comatulid species occurring between about 100 and 1000 m: numbers of species plotted by depth interval (meters).

Taxonomic problems, particularly at the species level, may also cripple faunal and biogeographic assessments. The KARUBAR material has permitted us to analyze morphological variability in greater detail than previously and, as a result, more accurately characterize some species and their diagnostic features. High coefficients of variation recorded for many features indicate substantial sample heterogeneity. Yet, enough intergradations permit us to synonymize several species formerly considered distinct (e.g., *Aglaometra sulcata*, *A. incerta* and *A. propinqua* under *A. valida*).

Because so much of comatulid structure is suspension-feeding apparatus, it follows, as with clonal organisms (e.g., WINSTON, 1979; BOERO, 1984; BRAZEAU & LASKER, 1988), that patterns of water movement might substantially affect morphology and account for at least some of the observed variability. Among comatulids, individuals of several nominal comasterid species (e.g., *Comanthus parvicirrus*, *C. wahlbergii*, *C. suavia*) in shallow (≤4 m) habitats subject to strong surge/wave action tend to have shorter more numerous arms than those in quieter (deeper or sheltered) water (MESSING, 1994). Among stalked crinoids, AMÉZIANE-COMINARDI (1991: 45) noted that: "il existe une relation entre la position géographique qui s'accompagne de conditions hydrodynamiques diverses et les variations morphologiques observées au sein de ces trois taxons [*Metacrinus serratus*, *M. costatus* et *M. levii*]. L'hydrodynamisme va être un facteur limitant majeur pour les *Metacrinus*. Dans un environnement calme et stable tel qu'au Sud-Ouest des Phillipines va se développer une faune aux caractères morphologiques constants. Alors qu'en Nouvelle-Calédonie, les spécimens qui vivent dans des courants plus forts, présentent une plus forte variabilité des caractères morphologiques et un nombre de bras moindre."

However, the KARUBAR collection notwithstanding, we yet lack virtually all of data needed to determine what constellation of genetic, ontogenetic, biomechanical and energetic constraints, and environmental factors generate the variability observed within and between comatulid skeletal components.

SUMMARY OF PROPOSED TAXONOMIC CHANGES

NEW TAXON:

Neometra xenocladia

Source : MNHN, Paris

NEW SYNONYMS:

Antedon incerta Carpenter, 1888, a synonym of *Aglaometra valida* Carpenter, 1888.
Crotalometra propinqua A.H. Clark, 1911, a synonym of *Aglaometra valida* Carpenter, 1888.
Crotalometra sulcata A.H. Clark, 1912b, a synonym of *Aglaometra valida* Carpenter, 1888.
Thalassometra magna A.H. Clark, 1912b, a synonym of *Oceanometra annandalei* (A.H. Clark, 1909d).
Stenometra snelliusi A.H. Clark, 1936, a synonym of *Stenometra cristata* A.H. Clark, 1911.

NAMES WITH CHANGED STATUS:

Palaeocomatella A.H. Clark, 1912a, removed from the synonymy of *Comissia* A.H. Clark, 1909e (HOGGETT & ROWE, 1986).
Stenometra cristata A.H. Clark, 1911, removed from the synonymy of *Stenometra quinquecostata* Carpenter 1888 (A.H. CLARK, 1950).

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Source : MNHN, Paris

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Source : MNHN, Paris

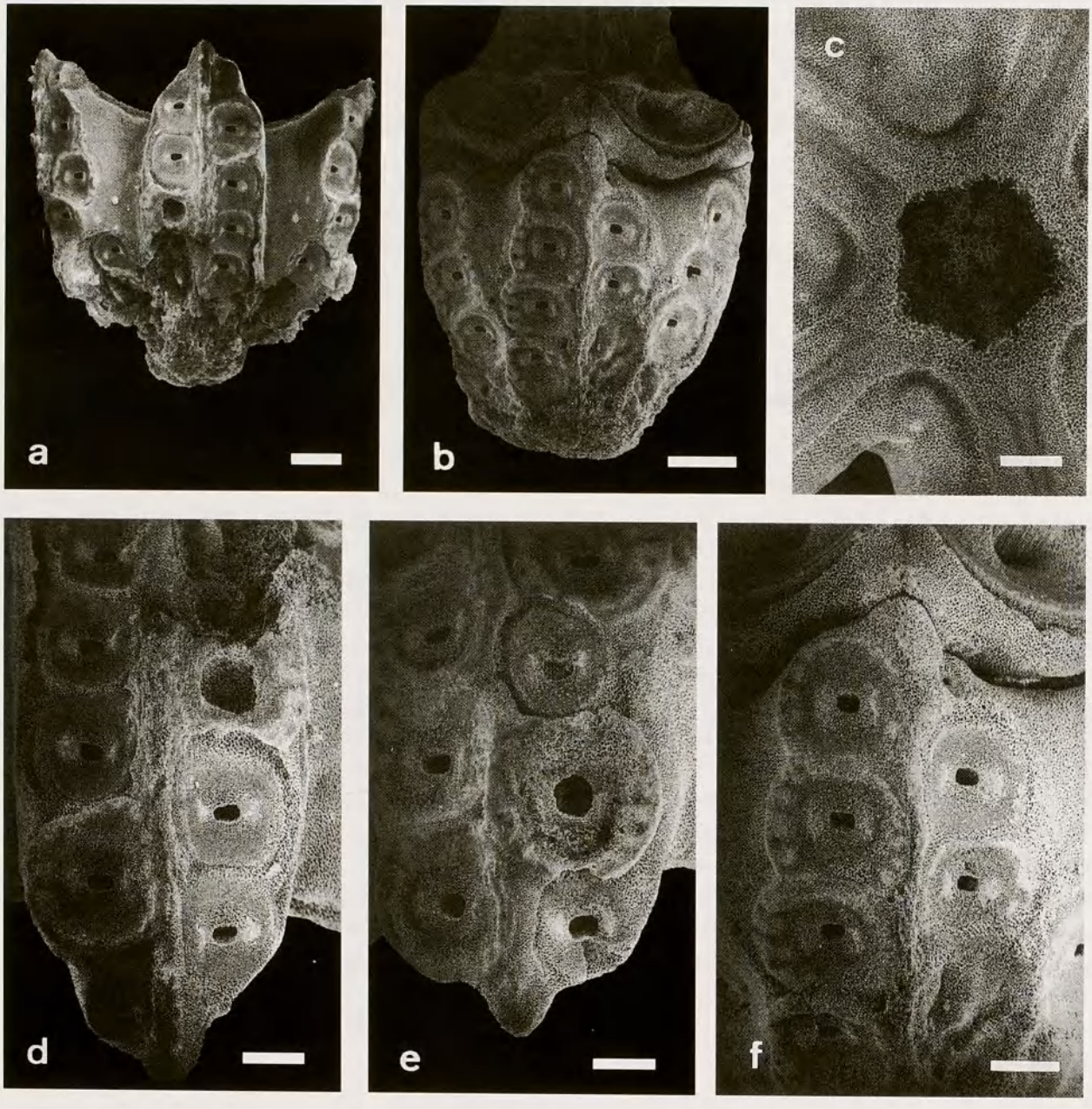

FIG. 29. — *Oceanometra annandalei* (EcCh49) (SEM): **a-c**, Centrodorsals, **a-b**, lateral views of two different specimens; **c**, oral surface of a; **d-f**, lateral views of adjacent pairs of cirrus socket columns separated by narrow interradial ridges (three different specimens). Scale bars: a-b = 1.0 mm; c-f = 0.5 mm.

Source : MNHN, Paris

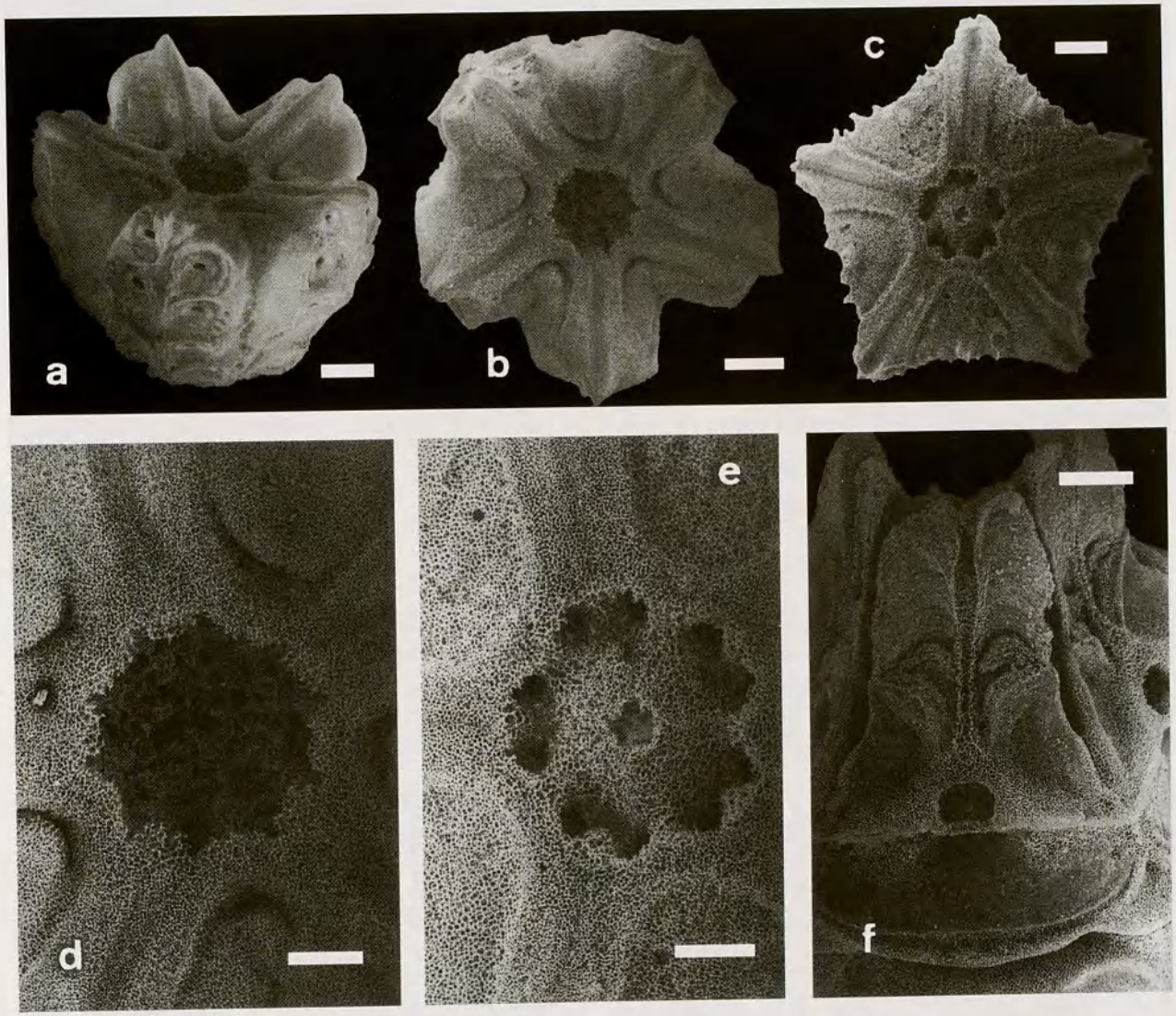

FIG. 30. — *Oceanometra annandalei* (EcCh49) (SEM): **a**, Oblique view of centrodorsal showing concave oral surface; **b**, oral surface of centrodorsal; **c**, radial circlet, oral view; **d**, detail of b showing central cavity; **e**, detail of c showing basal rosette; **f**, radial articular facet. Scale bars: a-c = 1.0 mm; d-f = 0.5 mm.

Source : MNHN, Paris

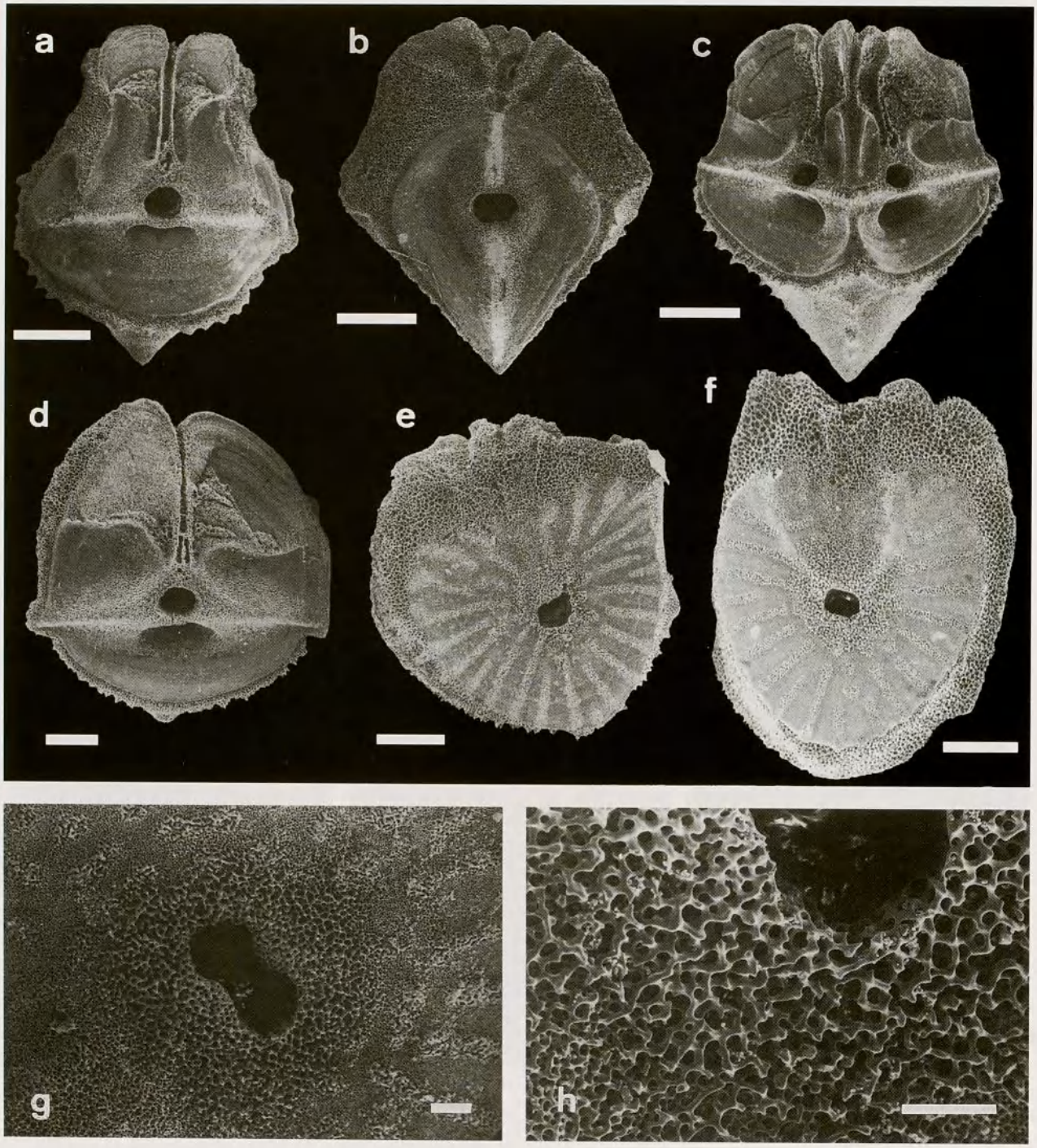

FIG. 31. — *Oceanometra annandalei* (a-e, EcCh 49; f-h, EcCh 51) (SEM): **a**, Ibr_1, muscular articular facet; **b**, Ibr_2 axil, synarthry; **c**, distal view of Ibr_2 showing paired muscular articular facets and triangular aboral surface; **d**, $IIbr_1$, muscular articular facet; **e**, br_6 , syzygy; **f**, br_4, syzygy; **g**, $IIIbr_3$, note isolated patches of raised stereom between central raised periaxial region (around lumen) and radiating culminae; **h**, $IIIbr_3$, showing periaxial stereom. Scale bars: a-c = 1.0 mm; d-f = 0.5 mm; g-h = 100 µm.

Source : MNHN, Paris

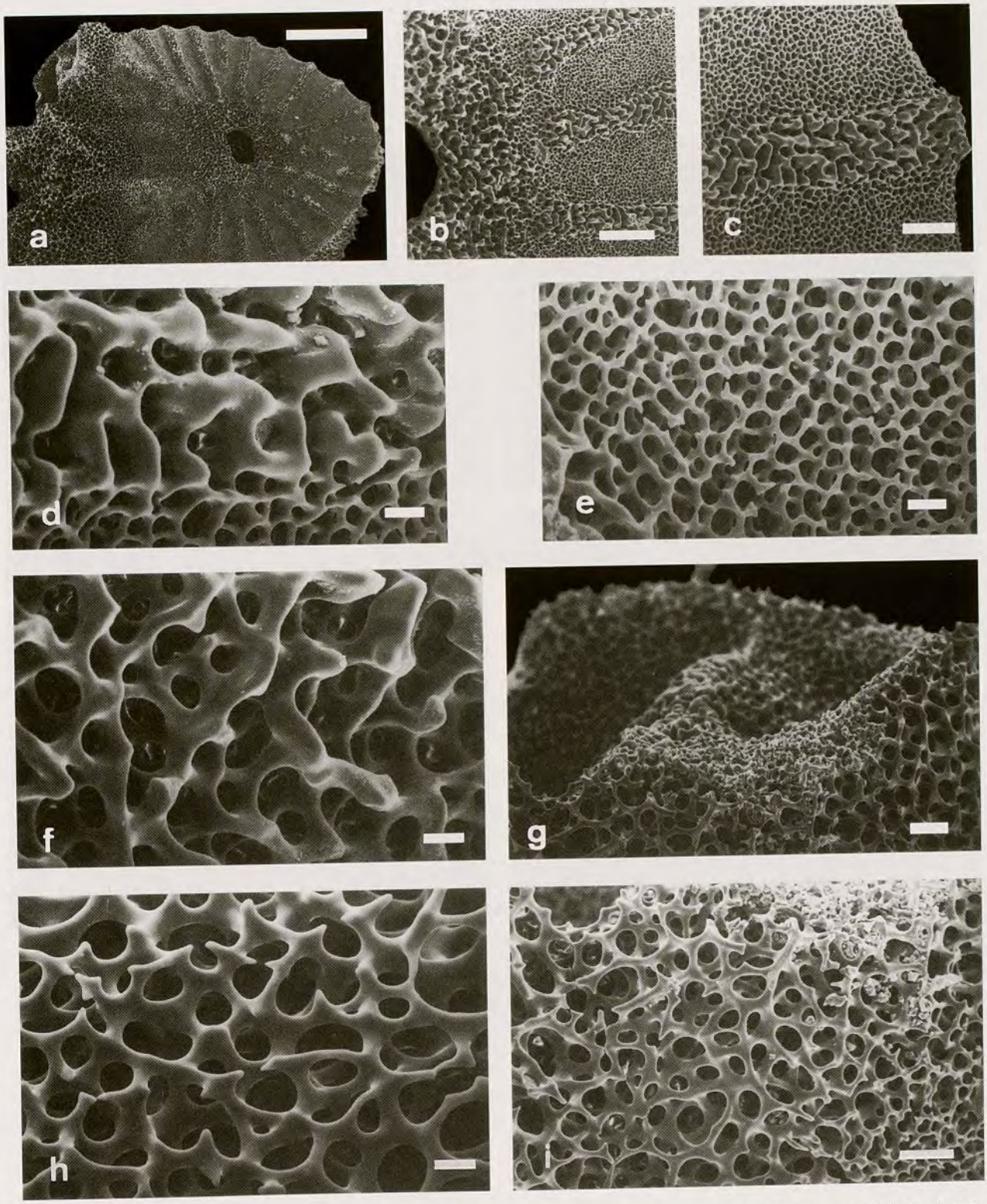

FIG. 32. — *Oceanometra annandalei* (EcCh 51) (SEM): **a**, br_3, syzygy with pinnular articulation at upper left; **b**, detail of a showing raised periaxial region around lumen at left; **c**, detail of a showing culmina (ridge); **d**, detail of culmina in c; **e**, detail of crenella (flat area between culminae) in b; **f**, detail of periaxial region in a; **g**, detail of pinnular articulation in a; **h**, detail of g, showing deep probable muscular fossa stereom; **i**, detail of g, stereom between pinnular articulation and syzygial facet. Scale bars: a = 0.5 mm; b = 100 µm; c, g, i = 50 µm; d-f, h = 10 µm.

Source : MNHN, Paris

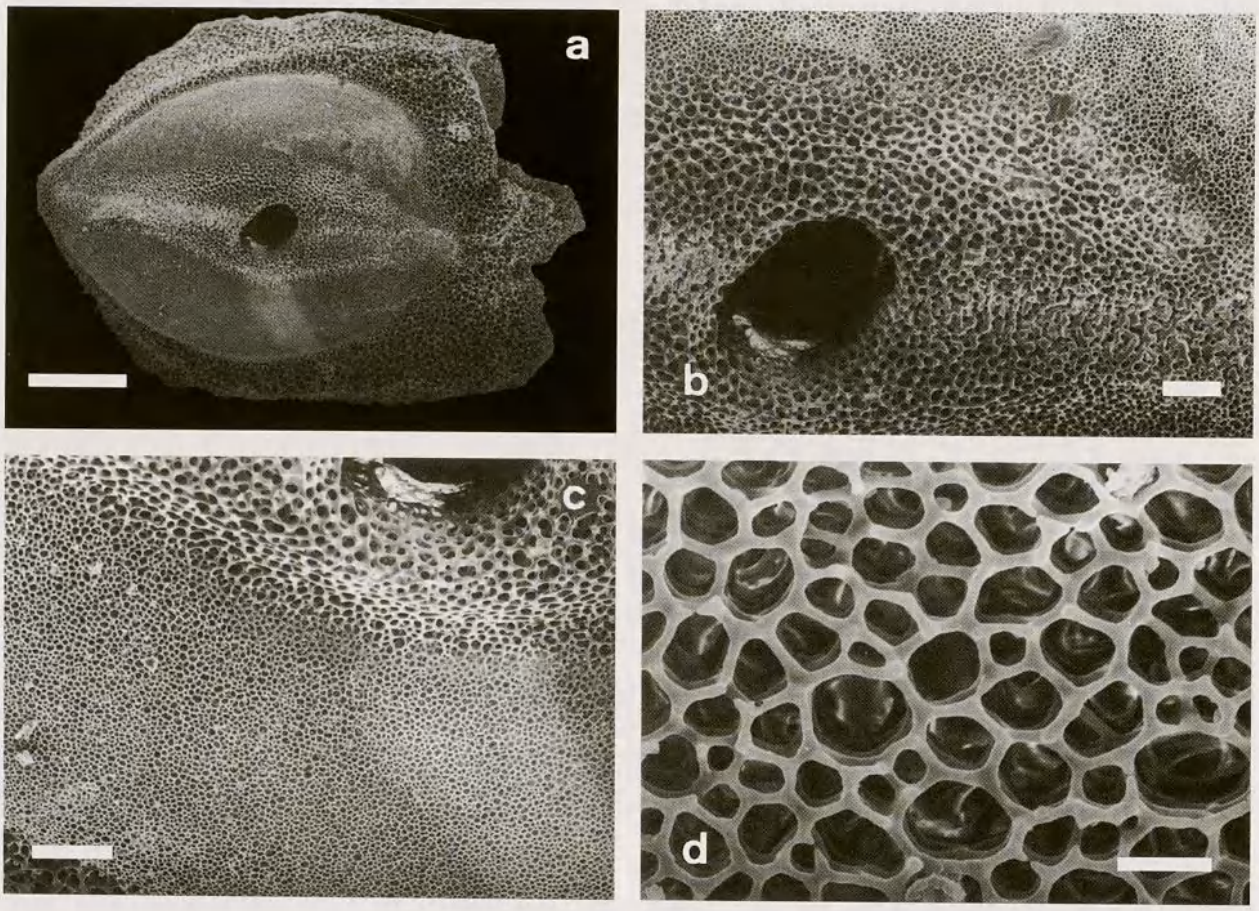

FIG. 33. — *Oceanometra annandalei* (EcCh 51) (SEM). br_2, synarthry: **a**, entire ossicle; **b**, detail showing central lumen and fulcral ridge; **c**, detail showing ligamentary fossa; **d**, detail of c, ligamentary stereom. Scale bars: a = 0.5 mm; b-c = 100 µm; d = 10 µm.

Source : MNHN, Paris

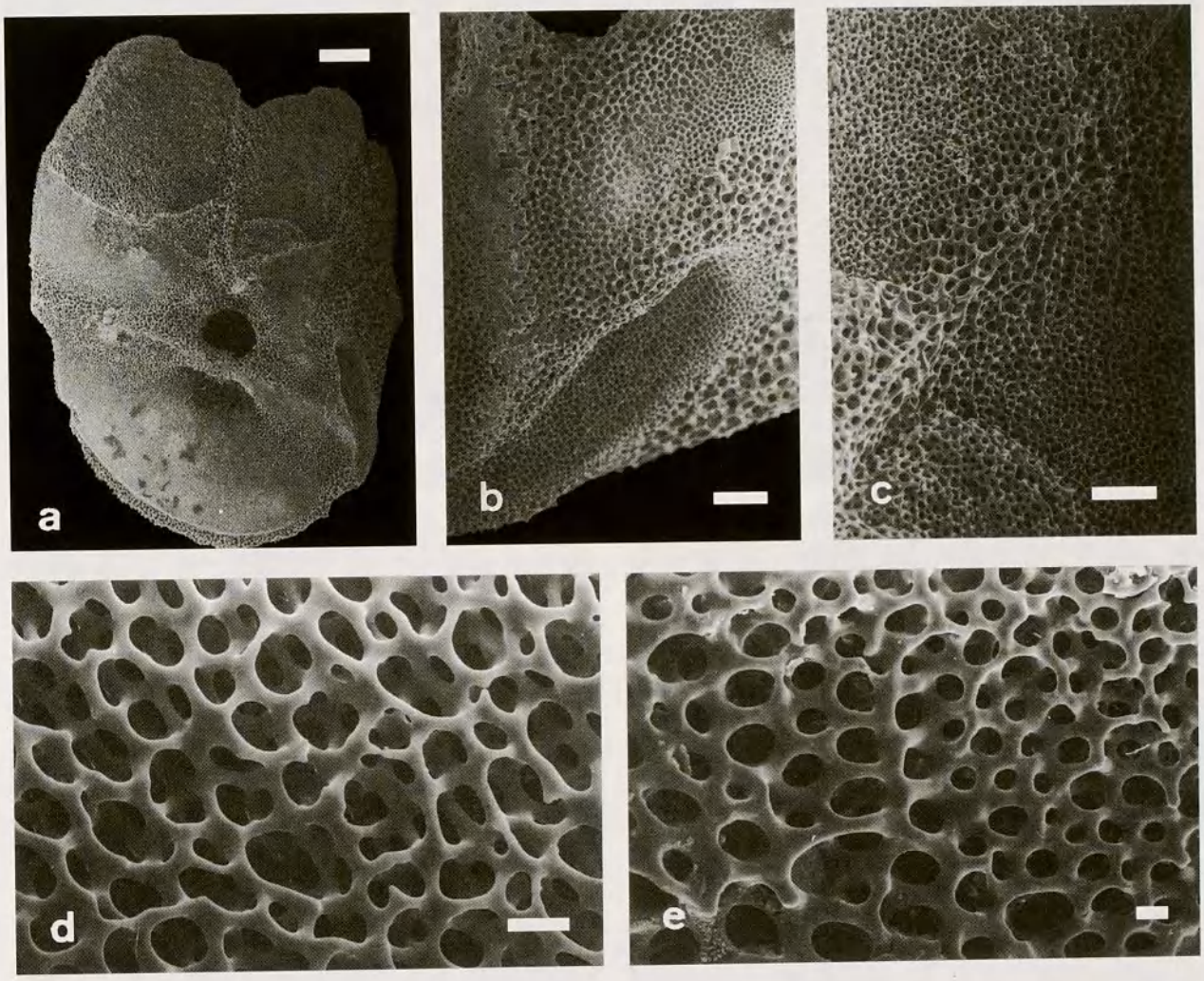

FIG. 34. — *Oceanometra annandalei* (EcCh 51) (SEM). br_1, muscular articulation: **a**, entire ossicle; **b**, detail of a, fulcral ridge (left) and elongated lateral fossa that accommodates the ligament that unites adjacent br_1; **c**, detail of a, ridge between paired muscular fossae; **d**, detail of b, stereom in lateral ligamentary fossa; **e**, detail of c, muscular fossa stereom. Scale bars: a = 0.25 mm; b-c = 100 µm; d-e = 10 µm.

Source : MNHN, Paris

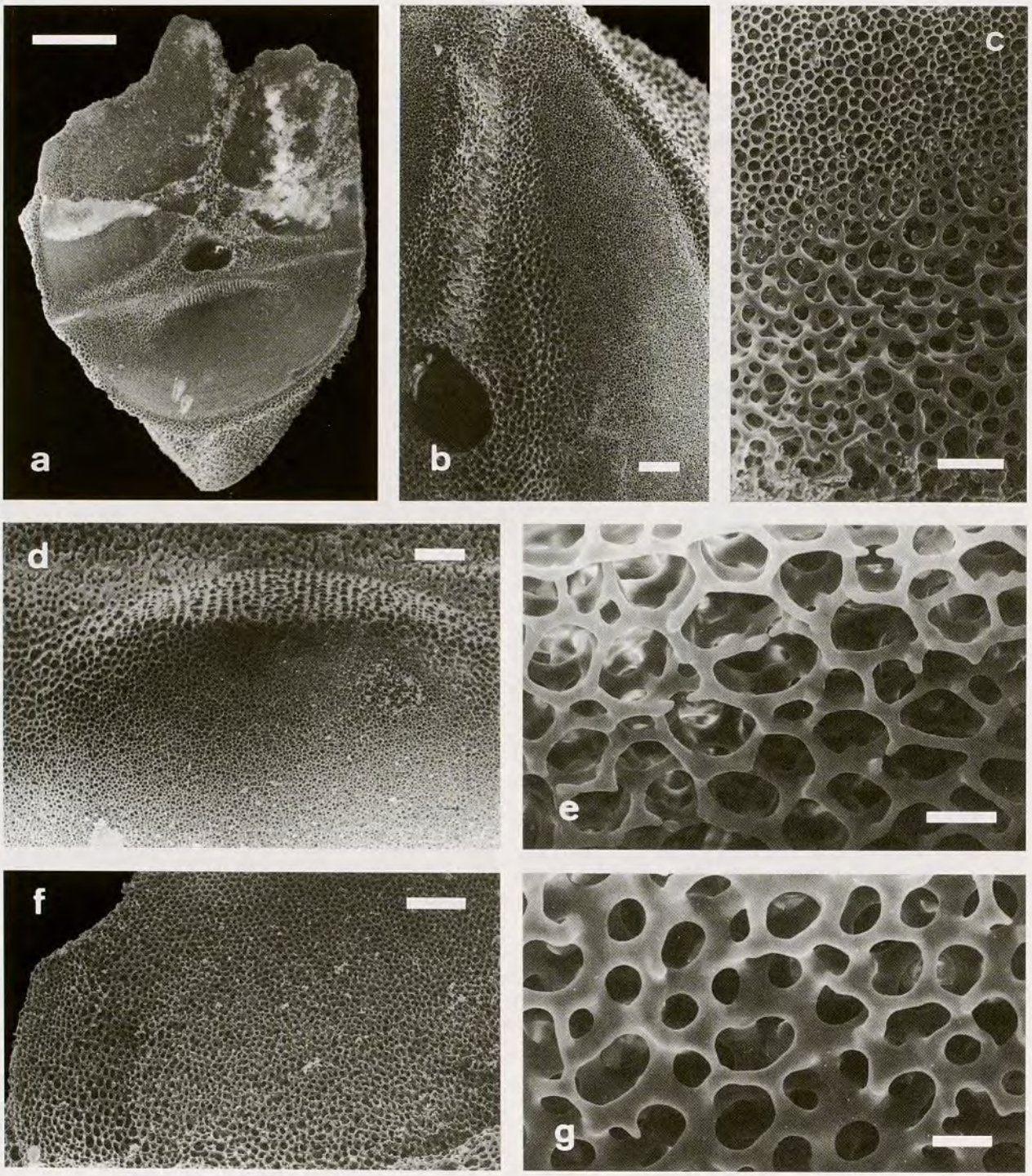

FIG. 35. — *Oceanometra annandalei* (EcCh 51) (SEM). br_2, muscular articulation: **a**, entire ossicle; **b**, detail of a, lumen, fulcral ridge and aboral ligament fossa; **c**, detail of b, gradation in stereom from ligamentary fossa (fine) to fulcral ridge (coarse); **d**, detail of a, fulcral ridge, ligament pit and aboral ligamentary fossa; **e**, detail of d, ligament pit stereom; **f**, detail of a, left muscular fossa; **g**, detail of f, muscular fossa stereom. Scale bars: a = 0.5 mm; b, d, f = 100 µm; c = 50 µm; e, g = 10 µm.

Source : MNHN, Paris

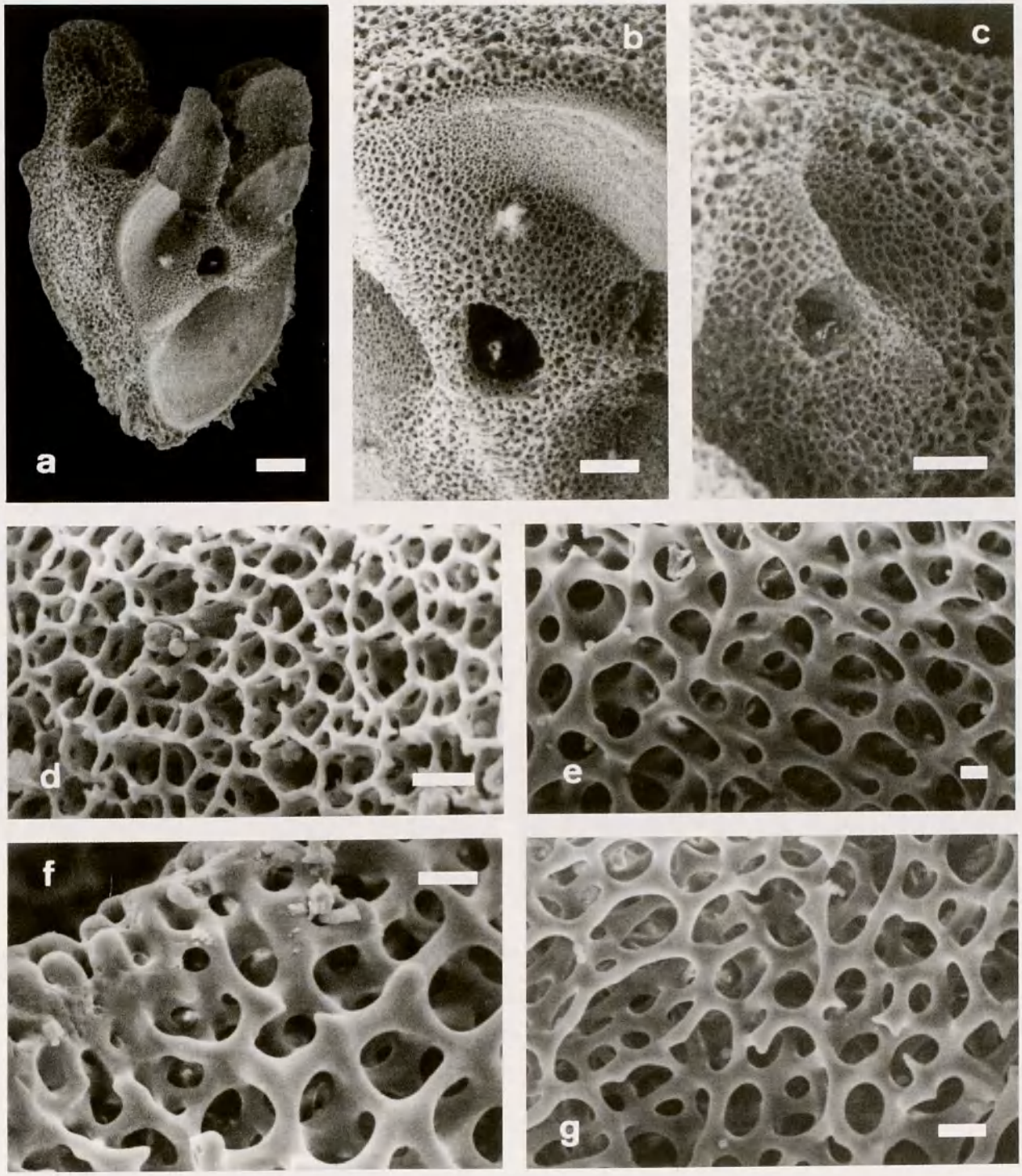

FIG. 36. — *Oceanometra annandalei* (EcCh 51) (SEM). br_{51}, muscular articulation: **a**, entire ossicle, oblique view showing pinnule articulation; **b**, detail of a, lumen and left interarticular ligament fossa; **c**, detail of a, pinnule articulation; **d**, detail of b, interarticular ligament fossa stereom; **e**, detail of b, periaxial stereom; **f**, detail of c, periaxial stereom of pinnule articulation fulcral ridge; **g**, detail of c, pinnule articulation, stereom of fossa closest to brachial muscular fossa. Scale bars: a = 0.25 mm; b-c = 100 µm; d-g = 10 µm.

Source : MNHN, Paris

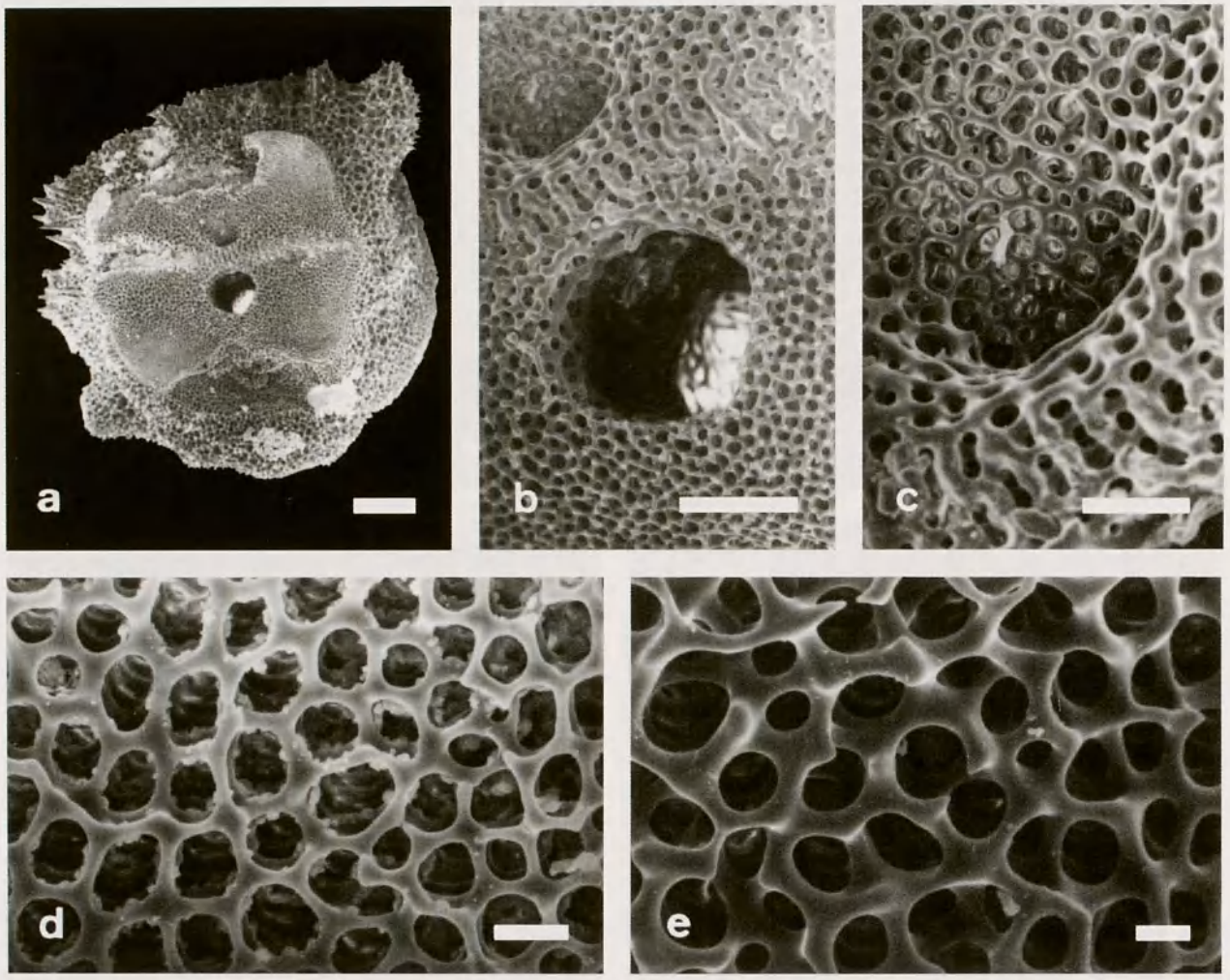

FIG. 37. — *Oceanometra annandalei* (EcCh 51) (SEM). P_1, articular facet of basal pinnular: **a**, entire ossicle; **b**, detail of a, lumen (center), fulcral ridge and ligament pit (upper left); **c**, detail of b showing fulcral ridge and ligament pit; **d**, detail of a, ligamentary fossa stereom (upper right of a); **e**, detail of c, ligamentary stereom adjacent to ligament pit. Scale bars: a = 0.25 mm; b = 100 µm; c = 50 µm; d-e = 10 µm.

Source : MNHN, Paris

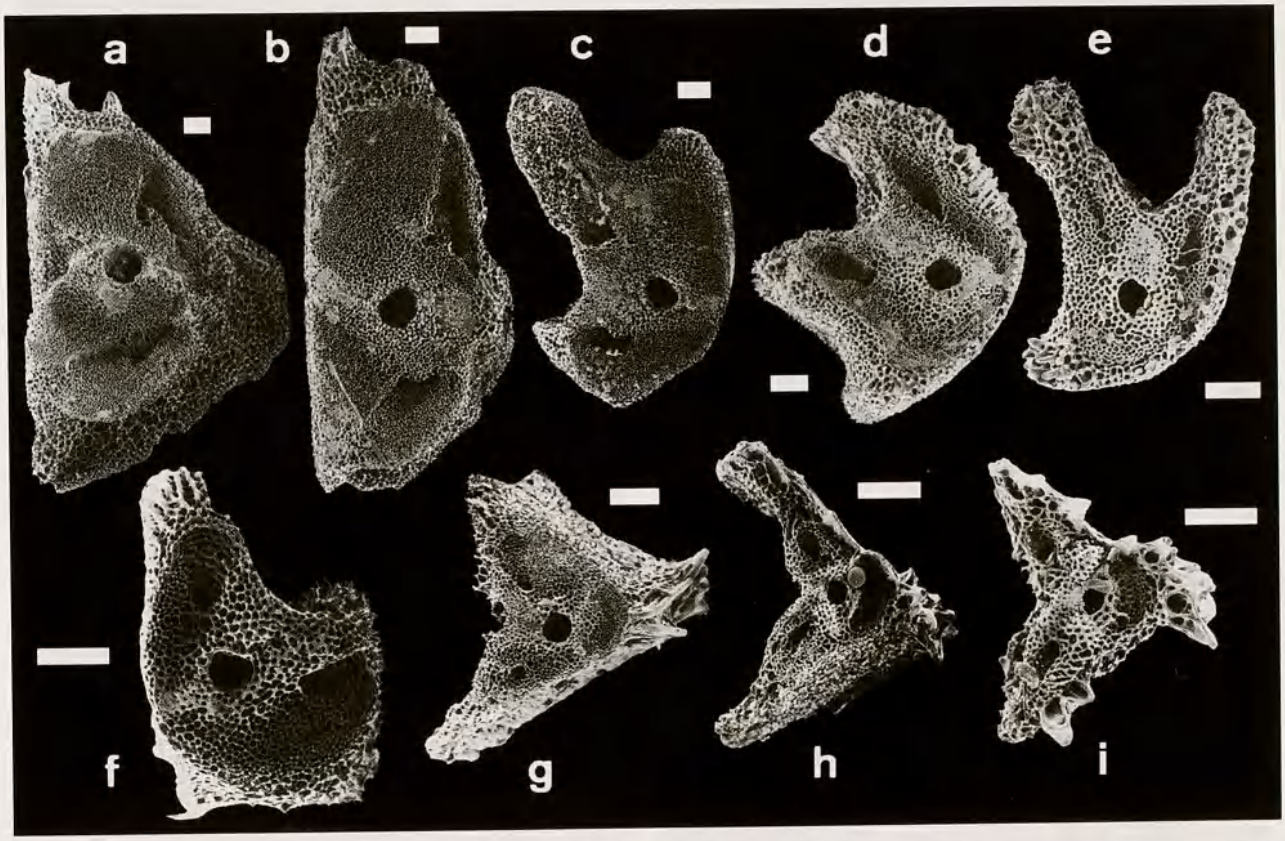

FIG. 38. — *Oceanometra annandalei* (EcCh 51) (SEM). **a-f**, P_2 articular facets: **a**, second pinnular; **b**, fourth pinnular; **c**, eighth pinnular; **d**, tenth pinnular; **e**, 24th pinnular; **f**, 28th pinnular. — **g-i**, distal pinnule articular facets: **g**, first pinnular; **h**, fourth pinnular; **i**, eighth pinnular. Scale bars: 100 µm.

Source : MNHN, Paris

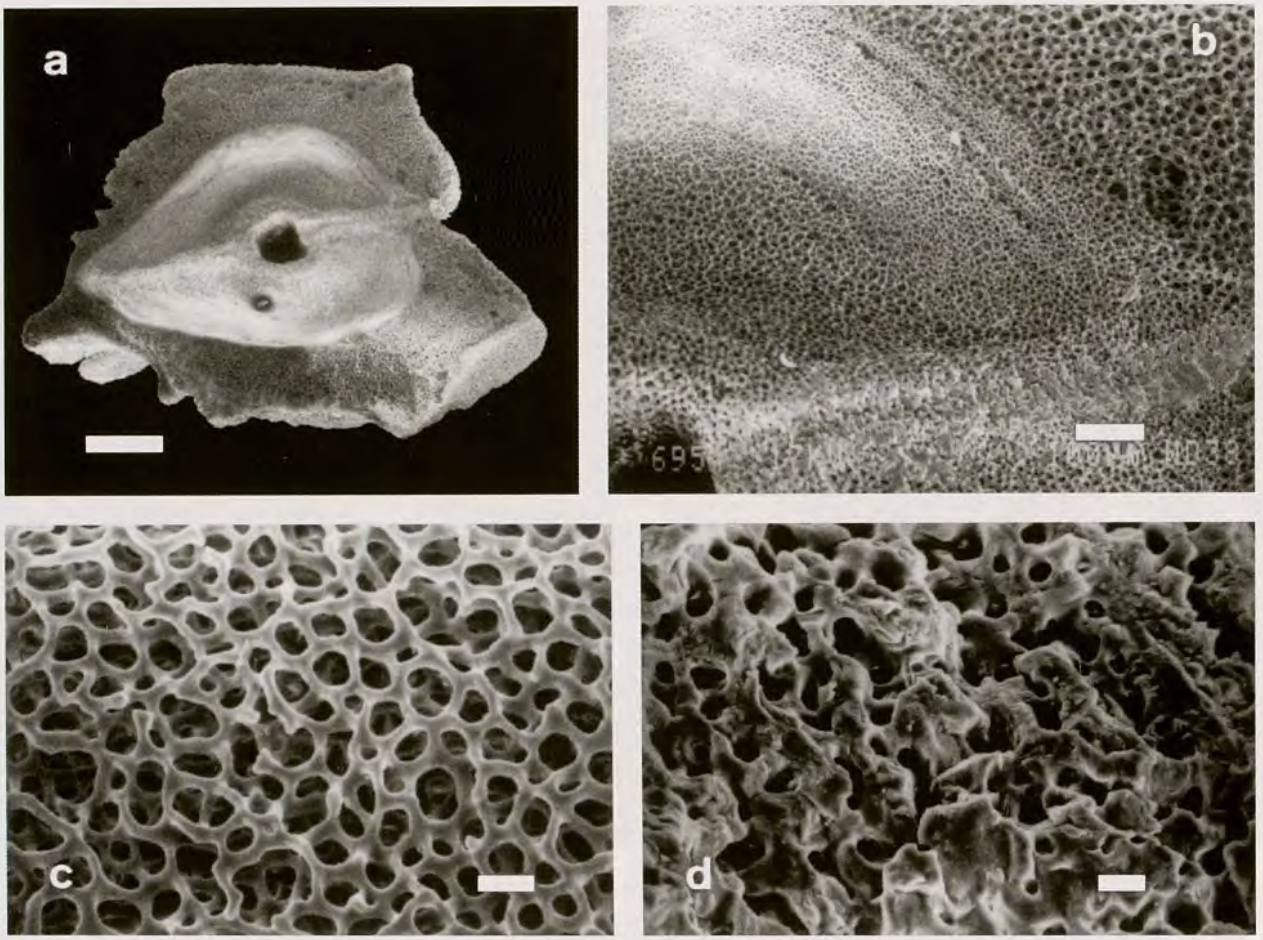

FIG. 39. — *Stenometra cristata* (EcCh 55) (SEM). Ibr_2, synarthry: **a**, entire ossicle; **b**, upper right detail of a, fulcral ridge and ligament fossa; **c**, detail of b, ligament fossa stereom; **d**, detail of b, fulcral ridge stereom. Scale bars: a = 0.5 mm; b = 100 µm; c-d = 10 µm.

Source : MNHN, Paris

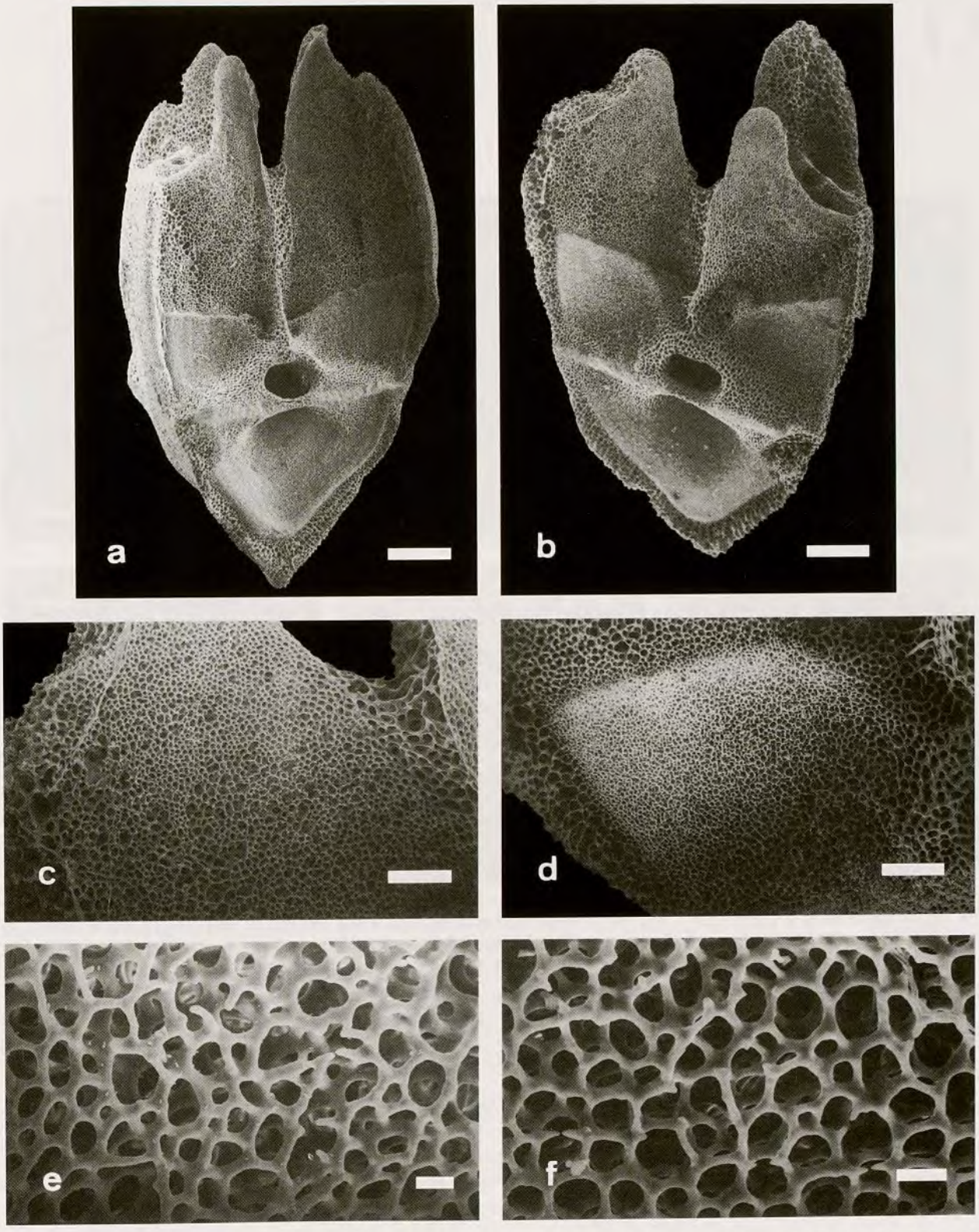

FIG. 40. — *Stenometra cristata* (EcCh 55) (SEM). Muscular articulation of brachials from a detached arm fragment: **a**, middle brachial, entire ossicle; **b**, more proximal brachial, entire ossicle (oblique view); **c**, detail of b, left muscular fossa; **d**, detail of b, left interarticular ligament fossa; **e**, detail of c, muscular fossa stereom; **f**, detail of d, interarticular ligament fossa stereom. Scale bars: a-b = 0.25 mm; c-d = 100 µm; e-f = 10 µm.

Source : MNHN, Paris

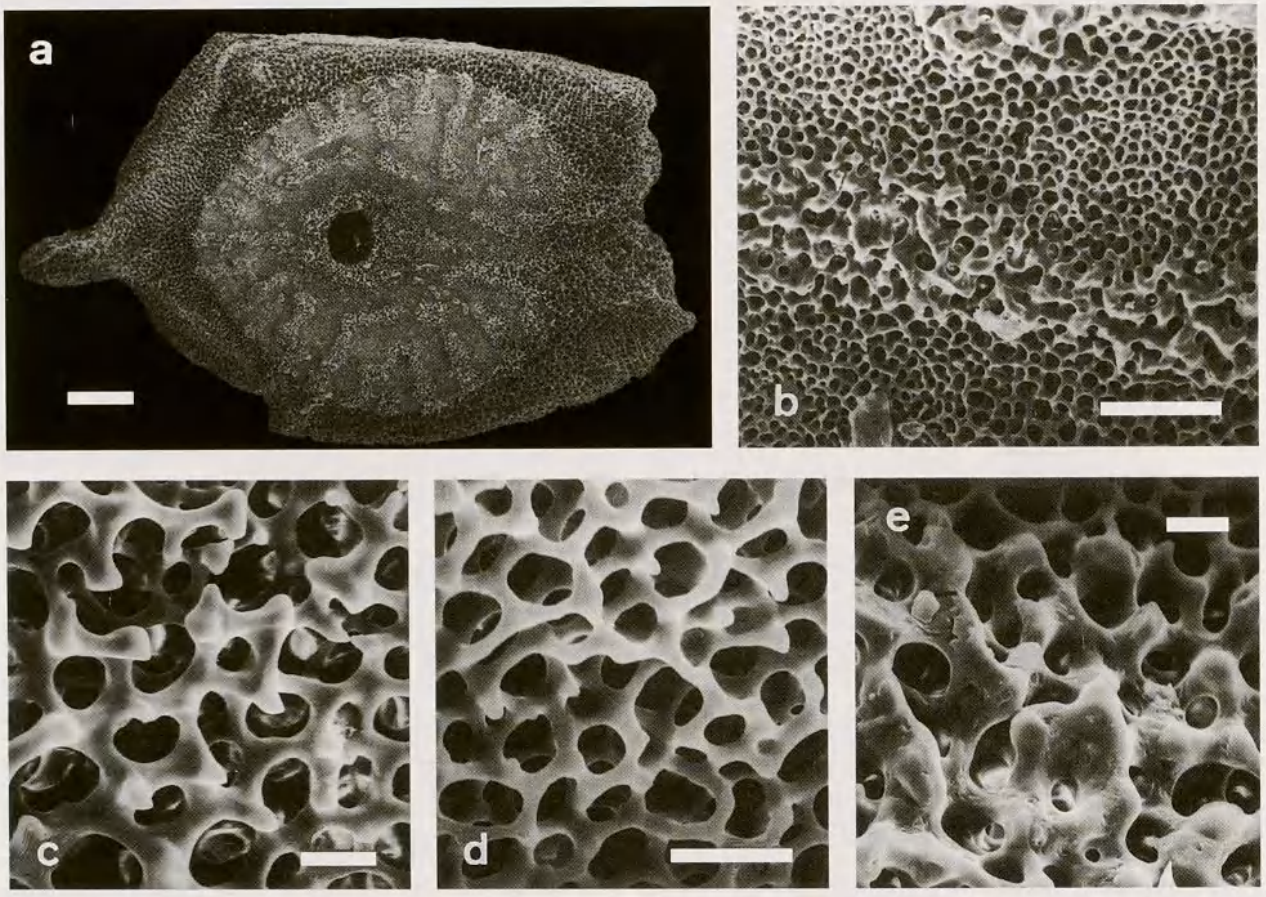

FIG. 41. — *Stenometra cristata* (EcCh 55) (SEM). Proximal brachial (detached arm fragment), syzygy: **a**, entire ossicle; **b**, detail of a, culmina (center) flanked by crenellae; **c**, detail of a, periaxial stereom; **d**, detail of a, crenellar stereom; **e**, detail of b, culmina stereom. Scale bars: a = 0.25 mm; b = 50 µm; c-e = 10 µm.

Source : MNHN, Paris

13

Ascidiacea: Plurellidae collected in the Pacific Ocean by the cruises MUSORSTOM, KARUBAR and the "Coral Reef Research Foundation"

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ABSTRACT

Collectings by deep SCUBA dives have brought up 4 new species of Plurellidae, a family known by 2 *Plurella* species and one *Microgastra*. A new genus *Plurascidia* is also described, intermediate between the Plurellidae and the Ascidiidae families. All these new species are compared to the 3 Plurellidae already known and to a strange deep Ascidiidae, *Fimbrora calsubia*.

RÉSUMÉ

Ascidiacea : Plurellidae récoltées dans l'océan Pacifique lors des campagnes MUSORSTOM et KARUBAR ainsi que par la Coral Reef Research Foundation.

Des plongées profondes en scaphandre autonome ont permis la récolte de quatre espèces nouvelles de Plurellidae, une famille qui ne comprenait jusqu'à maintenant que deux espèces de *Plurella* et une espèce de *Microgastra*. Un genre nouveau *Plurascidia*, intermédiaire entre les familles Plurellidae et Ascidiidae est décrit. Les espèces nouvelles sont comparées aux trois espèces déjà connues de la famille ainsi qu'à une étrange Ascidiidae de grande profondeur, *Fimbrora calsubia*.

INTRODUCTION

Several uncommon ascidians were collected in the tropical western and central Pacific ocean. The *Plurella* species were found by diving down to 100 m deep by people from the American Coral Reef Research Foundation, during a large biodiversity program at Palau and Philippines islands. The French MUSORSTOM cruises have

MONNIOT, F. & MONNIOT, C., 2000. — Ascidiacea: Plurellidae collected in the Pacific Ocean by the cruises MUSORSTOM, KARUBAR and the "Coral Reef Research Foundation". *In* : A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 21. *Mémoires du Muséum national d'Histoire naturelle*, **184** : 703-721. Paris ISBN 2-85653-526-7.

Source : MNHN, Paris

collected by dredging: *Microgastra granosa* Kott, 1973 and *Fimbrora calsubia* Monniot & Monniot, 1991 (off Vanuatu and New Caledonia), *Plurascidia marquesana* sp. nov. (around the Marquesas Islands). These collections were made with the objective of an inventory of tropical Pacific invertebrates from the shore to the bathyal area. Numerous unknown animals were collected and 4 new species of ascidians are described here.

The materiel studied here is deposited at the Muséum national d'Histoire naturelle at Paris.

Family PLURELLIDAE Kott, 1973

The Plurellidae Kott, 1973 is a family in which the branchial structure is a flat tissue pierced by numerous elongated stigmata, with longitudinal vessels and erect papillae at the crossings with the transverse vessels. Their neural ganglion associated to the neural gland is particularly far from the prepharyngeal groove, a structure only observed in the Phlebobranchia. Nevertheless, some original characters have to be noted. The gonads are not linked to the gut but lie into the body wall as in Stolidobranchia. There is no dorsal tubercle but small ciliated pits at the end of multiple short branches of the neural duct, issued from the neural gland. This last structure is characteristic of the genus *Phallusia*, but the latter has a dorsal tubercle well developed.

Genus ***PLURELLA*** Kott, 1973

The Plurellidae are particularly difficult to observe as the tunic is totally impregnated with coarse sand and some organs are included in this sandy tunic (Fig. 1). Even in samples of *Plurella* carefully collected by SCUBA, the arrangement of the zooids remains unclear. The zooids cannot be separated from each other without damage, and the sand has to be removed grain by grain to observe the heart, gonads and neural ganglion. We have tentatively tried to follow the course of the blood vessels through the tunic by stains, to demonstrate a link between the zooids, but without success. There is a complex network of blood sinuses, especially on the left side of the body but no crossing from one zooid to another could be proved.

We tentatively tried to find buds but without success. The zooids are so fused by their tunics that a colonial structure remains possible in the oviparous genus *Plurella* but we presently prefer to speak of agglomerated zooids instead of colonies.

The species of the genus *Plurella* have all the same external shape with coalescent zooids enclosed in a tunic embedded with coarse sediment and diverse debris. Some epibionts are settled at the colony surface or into the spaces left open between groups of zooids, actinians for example. The siphons' colour only varies from pale yellow to orange (Fig. 1). Their rim is not impregnated with sand. The internal morphology needs a careful examination to distinguish the species. A single anatomical character cannot be sufficient to define a taxon, but the combination of several elements has to be taken into account, the number of studied samples being too small to estimate an intraspecific variability.

The length of the siphons varies a little according to the place of the zooid, or between two groups collected in a same station. On the other hand, the presence of one or several ovaries, the place of the testis with regard to the heart, the shape of the gut, the position of the cloacal siphon or the location of the oral tentacles can constitute specific distinctive elements.

All species only have muscles on the right body side arranged in transverse bundles.

In a first group having only one ovary we find *Plurella testacea* sp. nov. collected at the Philippines and *P. monogyna* sp. nov. collected at the Philippines and Palau islands for this collection. These species differ by the place of the tentacle circle, the shape of the gut and the location of the testis related to the heart. The structure of the tunic on the right body side is also different.

In the second group having several ovaries are *P. kottae* Monniot & Monniot, 1996 and *P. melanesia* sp. nov. in addition to *P. elongata* Kott, 1973.

Source : MNHN, Paris

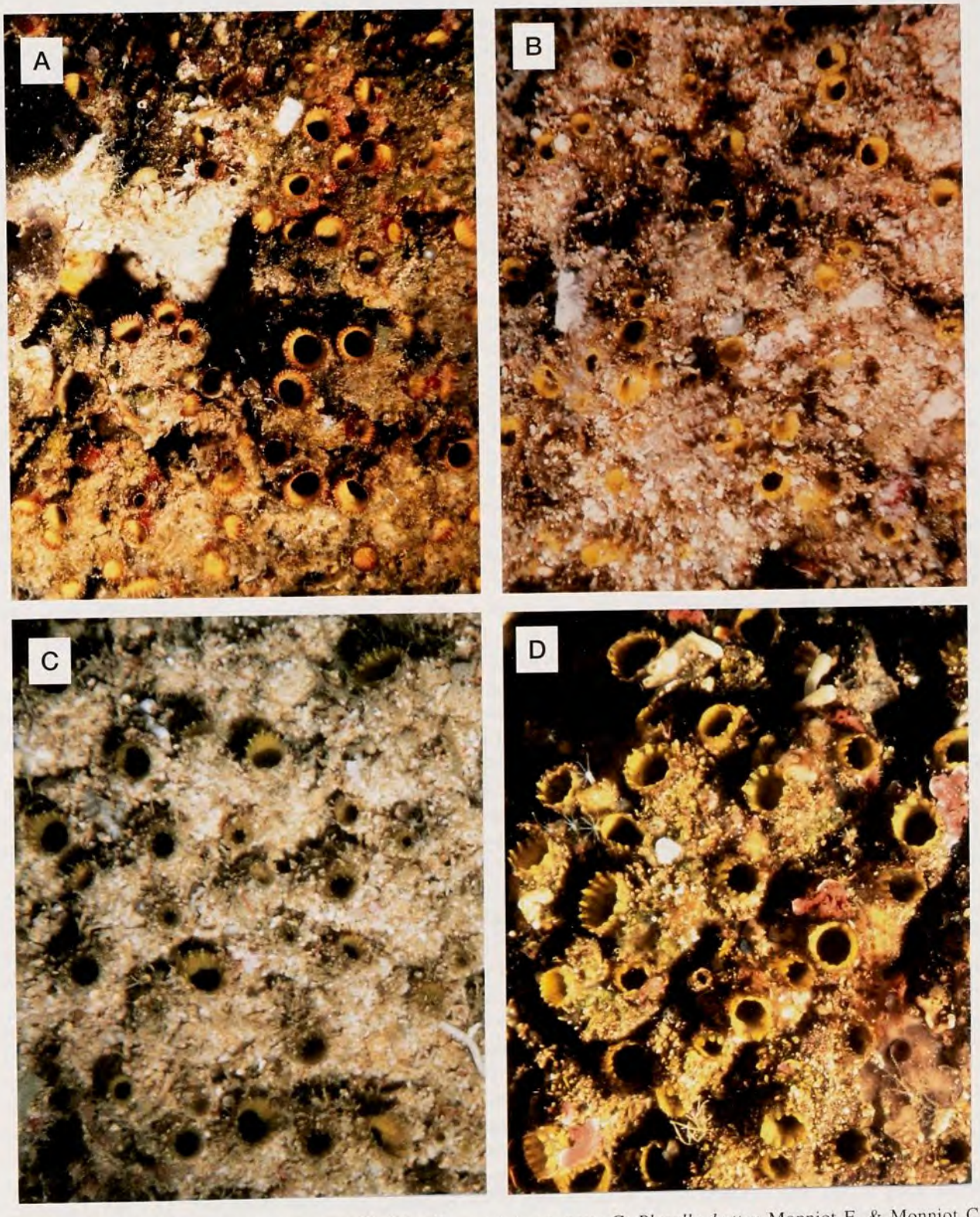

FIG. 1. — **A**, *Plurella monogyna* sp. nov.; **B**, *Plurella testacea* sp. nov.; **C**, *Plurella kottae* Monniot F. & Monniot C., 1996; **D**, *Plurella melanesiae* sp. nov.

Source : MNHN, Paris

Plurella monogyna sp. nov.

Figs 1A, 2A, 3

MATERIAL EXAMINED. — Coral Reef Research Foundation coll.
Philippines. *Cebu*: Cabilao, 20 m (MNHN P7 Plu 17).
Bohol Sea : SW Panglao Island, 09°31.26'N, 123°41.05'E, 10 m, 16.04.1997.
Palau. *Helen's Reef*: 02°52.27'N, 131°44.41'E, 18 m, 12.12.1996.

TYPE. — MNHN P7 Plu 17: Philippines, Cebu, Cabilao, 20 m deep.

DESCRIPTION. — The agglomerated individuals make thick cushions, entirely embedded with sand (Fig. 1A). The largest mass is 12 cm in diameter and 5 cm thick. In life the animals are half buried into the sediment. The zooids are linked to each other by their tunic, more strongly by the left body side and the base of the cloacal siphon. Some expansions of tunic, densely embedded with sand, arise from the base of the zooids as anchoring parts. Spaces exist between the groups of zooids, but we could not determine their shape or extension which are irregular.

The oral and cloacal siphons of a same diameter are free along about 1 cm, erect at the colony surface. Their naked extremity is orange in colour and dentate (Fig. 1A). Each siphon has a distal muscular sphincter crossed by very short longitudinal fibres. The cloacal siphon is shorter than the oral one but of a same diameter. It is inserted at one third of the body length (Figs 2A, 3A-B). It has an internal velum.

The test strongly adheres to the body wall except above the right side of the body which contains the muscles. At this level the tunic has 2 layers, one external embedded with sand and one internal thin but stiffer, which is not linked to the external layer and no more to the body wall. Not any link other than the tunic relies the zooids. Not any blood sinus going from one individual to the other has been found. At the level of the heart and gonads, and around the base of the cloacal siphon the tunic and the body wall are thicker and cannot be dissociated from each other. They are rich in blood sinuses. Dark pigment (in formalin) is present in the siphons and in the body wall vascular system were the design is a net. There are also pigment cells in the branchial sac.

The muscles are only present on the right side on the body (Figs 2A, 3B). They are strong transverse parallel fibres which do not reach the endostyle nor the dorsal line. The body wall is very thin on the left side, impossible to separate from the tunic without damage. The internal side of the oral siphon is covered with numerous minute papillae, especially developed in the space between the tentacles and the branchial sac.

The tentacles are numerous (Figs 2A, 3B), in a circle (more than 50 counted in one zooid), in 4 orders of size, at the base of the siphon. The prepharyngeal band is made of 2 blades, the most posterior the highest. It is pressed against the branchial sac. Dorsally it draws a deep oblique V to join the dorsal lamina, prolonged by 2 rims on each side of a groove. The dorsal lamina is the prolongation of the left blade, with a plain edge and ribs corresponding to the left transverse vessels.

The neural ganglion is slightly displaced on the left side at the base of the cloacal siphon (Fig. 3B), included in the body wall thickness. A neural gland not well defined is joined to it. A thin channel extends anteriorly inside the body wall up to the anterior part of the branchial fold. Multiple short ramifications ended in urns open into the cloacal cavity. The most anterior one is placed inside the dorsal prepharyngeal V.

No dorsal tubercle, as that of other Phlebobranchia ascidians, could be detected in the V delimited by the prepharyngeal groove. The stigmata of the first row are very close to the prepharyngeal band. There are very numerous stigmata rows. The longitudinal vessels (85 on each side in one individual) begin anteriorly to the first row of stigmata by a papilla and extend along the whole body length. Some additional longitudinal vessels progressively appear along the dorsal lamina at the rear part of the branchial sac. We counted 1 or 2 stigmata per mesh. The branchial papillae are rounded above each crossing with the transverse vessels.

The branchial sac forms a high fold beginning at the indentation of the prepharyngeal band and lies on the whole body length. The endostyle stops at the bottom of the branchial sac, down to the fold. The fold is attached along its whole length by strips similar to those uniting the branchial sac to the body wall.

The gut forms a closed loop (Figs 2A, 3B). It is almost free in the peribranchial cavity only linked to the branchial sac and the body wall by few blood vessels. In the most part of the zooids, the different parts of the gut

Source : MNHN, Paris

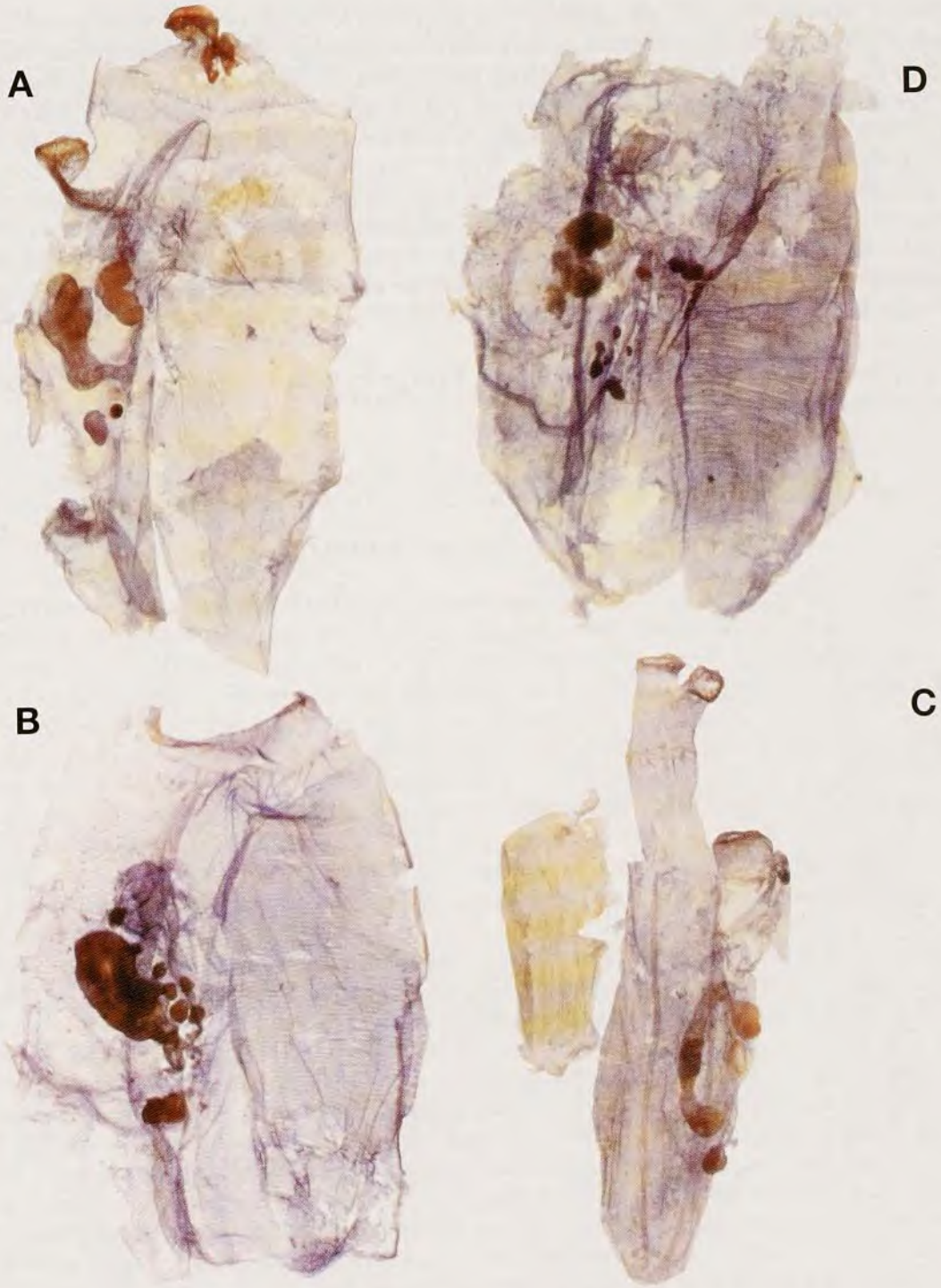

FIG. 2. — Dissections stained by hemalum.

A, *Plurella monogyna* sp. nov. : external side of a specimen opened ventrally to see the siphons, tentacles, upper part of the branchial sac, muscles, gut, gonads and heart.

B, *Plurella kottae* Monniot F. & Monniot C., 1996: external side of a specimen opened ventrally to see the gut and gonads.

C, *Plurella testacea* sp. nov. : on the right: part of the sclerified tunic, on the left specimen with a doubled oral siphon.

D, *Plurella melanesiae* sp. nov.: external side of a zooid opened ventrally showing several testes close to the heart and 3 ovaries lying at the side of the anus.

Source : MNHN, Paris

are not delimited when they are full, but sometimes it is possible to see a narrow oesophagus with a length equal to its diameter, followed by a spherical stomach and a tubular intestine entirely folded on itself and finally curved again, against the stomach, in a short rectum. Rarely the thin wall of the stomach is crumpled when emptied (Fig. 3A). The anus is widely open with a thickened rim. The gut is located in the middle of the body length. The heart forms a long arc in the posterior part of the body, crossing the whole left side from the endostyle to the base of the cloacal siphon close to the ovary (Figs 2A, 3A-B). There is dorsally a spherical hernia containing an inclusion (Figs 2A, 3B). The heart is partly included in the tunic and difficult to be dissociated from it.

The gonads are embedded into the tunic, with only one testis follicle and one ovary (Figs 2A, 3A-C). The testis is located behind the gut in the internal anterior side of the cardiac arc. It has an irregular outline, either in a compact rounded mass or more elongated with constrictions. The single sperm duct runs anteriorly along the heart to join the ovary and is there inflated in a large ampulla (Fig. 3C). The ovary is elongated and bean-shaped, ending in a wide oviduct (Fig. 3C).

The aggregated individuals collected at Palau only differ from those from Philippines by an oral siphon particularly long and very large zooids reaching 8 cm.

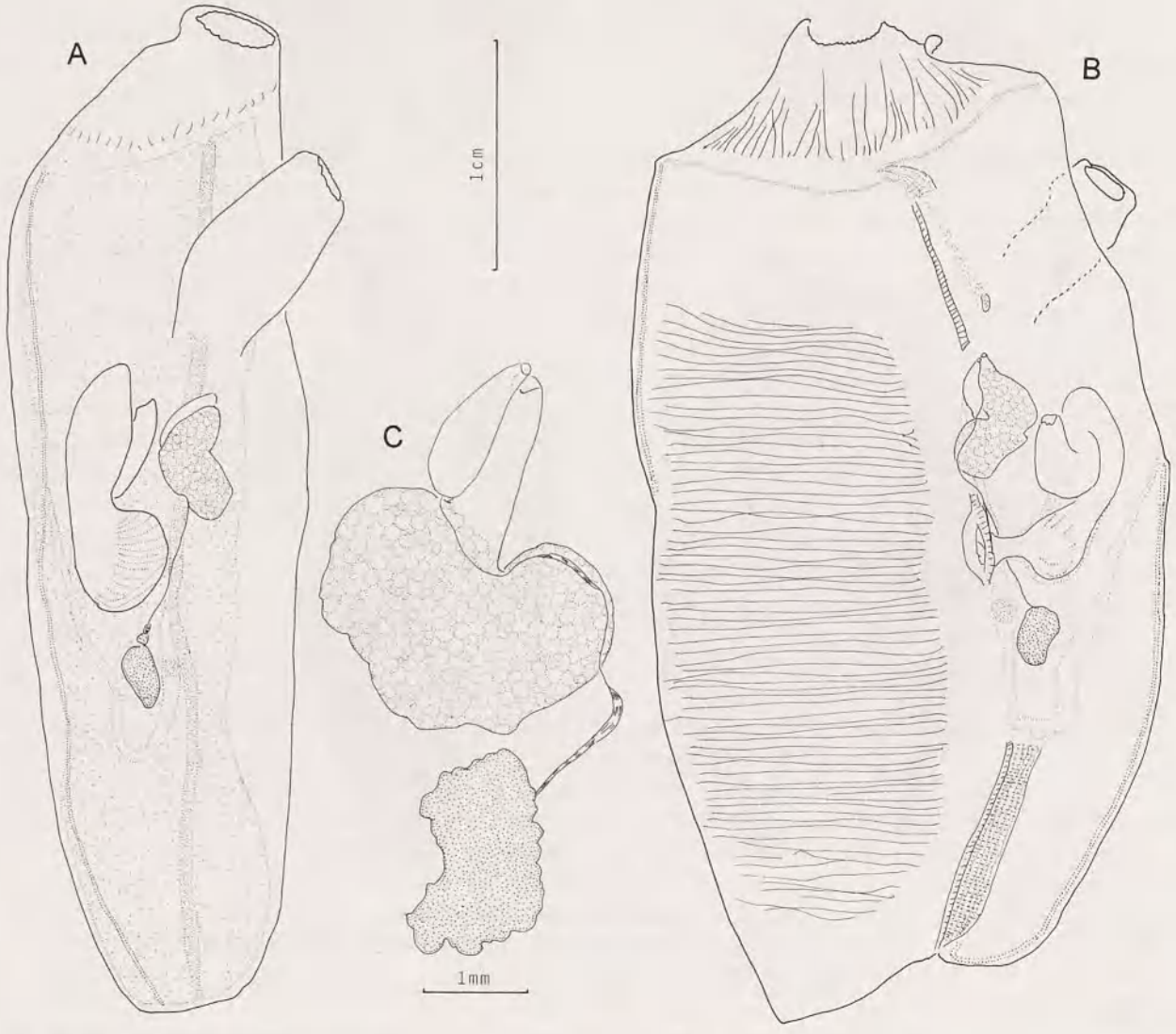

FIG. 3. — *Plurella monogyna* sp. nov.: **A**, external dorsal side with gut, gonads and heart; **B**, internal side of the body; **C**, detail of the testis and ovary.

Source : MNHN, Paris

REMARKS. — The conglomerate form as described above has exactly the same external characters as the solitary *Microgastra* specimens described by KOTT (1985). NISHIKAWA (1986) gave a very precise description of what he named *Ascidia* (?) *aenigmatica*, which he later synonymized (1991) with *Microgastra granosa* Kott, 1985. NISHIKAWA in 1991 mentioned 2 different solitary forms, one collected at Oki Islands with only one ovary, and one from Hakodate with several ovaries, which cannot belong to *P. monogyna* but to another different *Microgastra* species.

In 1985 following her description of *Plurella elongata*, KOTT mentions specimens from Philippines, insufficiently described but which may also belong to *Plurella monogyna*.

Considering the similarity of *Microgastra granosa* and its synonyms and the pseudo-colonies from Palau and the Philippines, a distinction between the genera *Plurella* and *Microgastra* is hazardous; nevertheless we retained it but only based on the solitary condition of *Microgastra* opposed to a possible colonial structure of *Plurella*.

Plurella testacea sp. nov.

Figs 1B, 2C, 4

MATERIAL EXAMINED. — Coral Reef Research Foundation coll.
Philippines. *Davao*: Pakiputan strait, 07°07.43'N, 125°40.18'E, 25 m, 29.03.1996 (MNHN P7 Plu 13).

TYPE. — Colony mentioned above (MNHN P7 Plu 13).

DESCRIPTION. — The pseudo-colony is embedded with coarse sand and varied debris (Fig. 1B). The zooids are about 6 cm long. They are incompletely and irregularly attached to each other, leaving cavities between the zooids. The specimen remains soft in spite of the heavy incrustation. The oral and cloacal siphons are free and their colour at the rim is sulphur yellow. The tunic is thin, colourless, vitreous except on the right side where it is brown, sclerified opaque and stiffer; there is no embedded sand at this level.

The oral siphon is clearly longer than the cloacal siphon (Fig. 2C). Its edge has no well marked lobes and only possesses a weak muscular sphincter. One of the zooids shows a doubled oral siphon (Fig. 2C). The internal side of the oral siphon is smooth. The cloacal siphon has a weak sphincter and a lobed margin. It begins at the half body-length and is directed anteriorly (Fig. 2C).

A circle of about 20 tentacles in two orders of length is at the anterior 2/5 of the length of the siphon (Fig. 2C), without velum. The prepharyngeal groove is thin, very posterior at the base of the oral siphon and cut in a deep dorsal V.

The body wall is extremely thin. Parallel transverse muscle fibres cover the half posterior part of the right body side (Figs 2C, 4A). On the left side the body wall is not very transparent and cannot be separated from the tunic except in the very posterior part of the body. Blood sinuses penetrate the tunic at the level of the endostyle, of the gut and of the gonads.

The branchial sac originates very close to the prepharyngeal groove. It is flat except the high dorsal fold characteristic of the Plurellidae (Fig. 4A). The longitudinal vessels begin by a papilla anterior to the first row of stigmata, and posteriorly bear papillae above each transverse vessel. We counted 1 to 2 long stigmata in a mesh. Frequently the stigmata rows are doubled and intermediate transverse vessels appear with their papillae. At its origin the dorsal lamina is made of two blades on each side of a short groove and it is posteriorly prolonged in a plain membrane. The dermato-branchial strips are numerous and irregular. The endostyle is wide and flat.

The neural ganglion is included in a thicker part of the body wall, strongly linked to the tunic, at the base of the cloacal siphon. The neural gland is not distinct, but a thin channel linked with multiple urn-shaped openings lies from the neural ganglion to the prepharyngeal V. The last ciliated pit takes place inside the dorsal V. The heart draws a wide arc from the endostyle to the dorsal line in the posterior part of the left body-side (Fig. 4A). Dorsally it has a hernia which contains a large inclusion.

The gut draws a longitudinal open arc (Figs 2C, 4A-B). The oesophagus is very short, narrow. The stomach is oval, the intestine is long, not curved in the rectal part. The anus is wide open at the base of the cloacal siphon.

The male and female gonads are distant from each other (Figs 2C, 4B). The massive testis is included inside the tunic, posterior to the heart. A long and thin sperm duct joins a globular ovary and expands in a large

Source : MNHN, Paris

ampulla. The ovary is located dorsally, close to the anus facing the arc made by the gut (Fig. 4B). It is embedded in the tunic.

REMARKS. — This species only differs from other *Plurella* species by internal characters which are, a brown thickened and sclerified tunic on the right side of the body (Fig. 2C); few oral tentacles planted very anteriorly in the siphon, far from the prepharyngeal groove; gonads made of a single testis mass posterior to the heart and a single ovary at the side of the intestinal loop; a gut slightly curved, elongated antero-posteriorly.

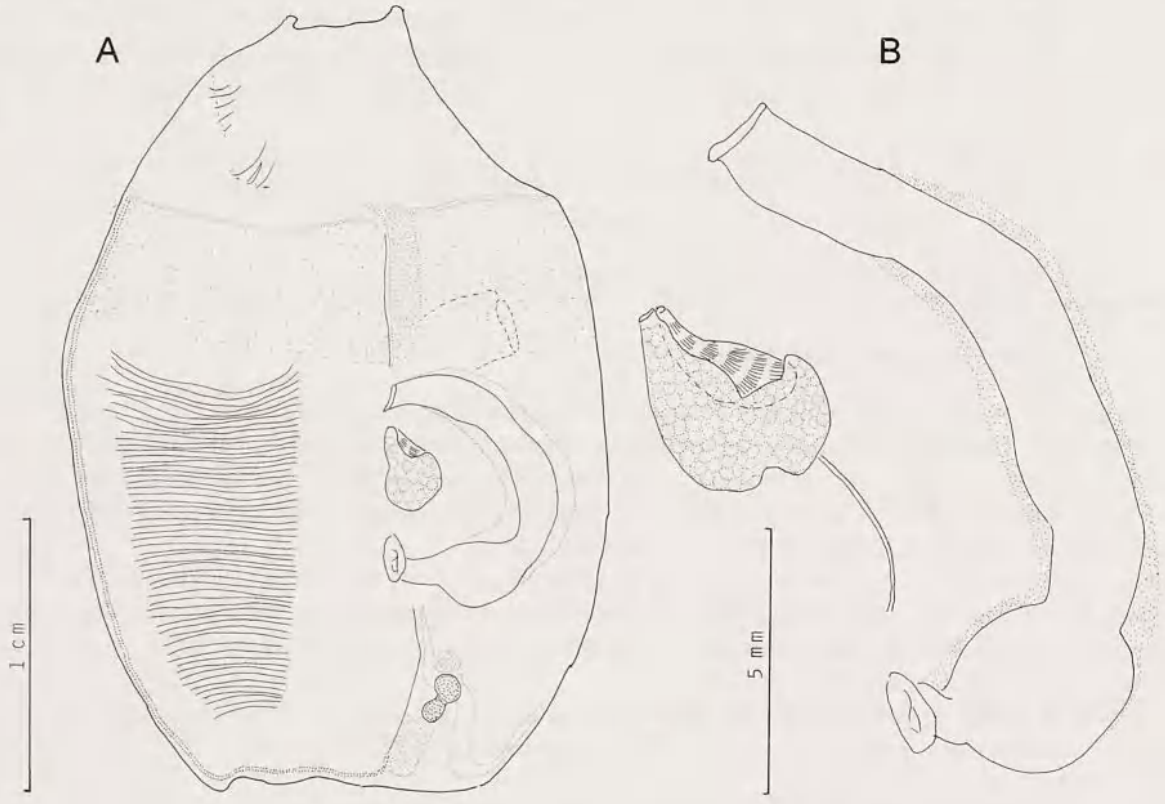

FIG. 4. — *Plurella testacea* sp. nov.: **A**, internal side of the body; **B**, detail of the gut and ovary.

Plurella kottae Monniot & Monniot, 1996
Figs 1C, 2B, 5

MATERIAL EXAMINED. — Coral Reef Research Foundation coll.
Philippines. *Mactan Island*: 10°17.19'N, 124°00.15'E, 27 m, 7.02.1994 (MNHN P7 Plu 1).
Cebu: no more information.
Palau. *Sea Bear*: 07°16.41'N, 134°31.43'E, 95 m.
Tsais Reef: 07°17.90'N, 134°13.80'E, 100 m.
Papua New Guinea. *Yuma Pass*: 11°22.14'S, 153°20.99'E, 40 m, 3.06.1998.

TYPE. — MNHN P7 Plu 1, Philippines, Mactan Island, 10°17.19'N, 124°00.15'E, 27 m .

DESCRIPTION. — In addition to the type sample, new specimens were collected in the Philippines and Palau islands. They allow to confirm and add some details to the previous description. The individuals, 2 to 3cm long are strongly aggregated (Fig. 1C) and lie on each other as roof-tiles with the same orientation. The siphon edge is yellow. Both siphons are short (Fig. 5A) with pointed lobes. The tunic is deeply impregnated with sand and

Source : MNHN, Paris

broken shells, but thin and translucent. On the right side it is separated into two layers, one external embedded with sediment and one internal, very thin, vitreous, soft and naked. This internal layer is not linked to the muscular body wall except along the endostyle and the dorsal line. On the left side, the tunic cannot be dissociated from the body wall and includes the heart and the gonads.

There are about 25 tentacles of irregular length and few other very small between them. The tentacles are located at the base of the siphon (Fig. 2B). The internal side of the oral siphon is covered with minute papillae. The prepharyngeal groove is close to the branchial tissue and curved in a sharp V. The body wall muscles extend transversally on the whole right side of the body. The oral sphincter is weak, the cloacal sphincter is stronger with short crossed longitudinal fibres.

The neural ganglion is oval at the base of the cloacal siphon. The neural gland was not seen . A group of urn-shaped vesicles opens anteriorly to the ganglion into the cloacal cavity, and few of them take place along the dorsal line, the last one opens in the dorsal V.

The branchial sac has a high fold extending from the prepharyngeal V to the bottom of the body. We counted 2 stigmata in a mesh. The longitudinal vessels possess one papilla at each crossing with the transverse vessels.

The oesophagus entrance is placed in the middle of the dorsal line. The gut forms a closed loop (Figs 2B, 5A), only attached to the branchial sac by few thin strips; The oesophagus is very short, not well separated from the stomach, that is only wider. The intestine is relatively long, folded on itself and a short rectum is curved anteriorly, ended in a wide anus.

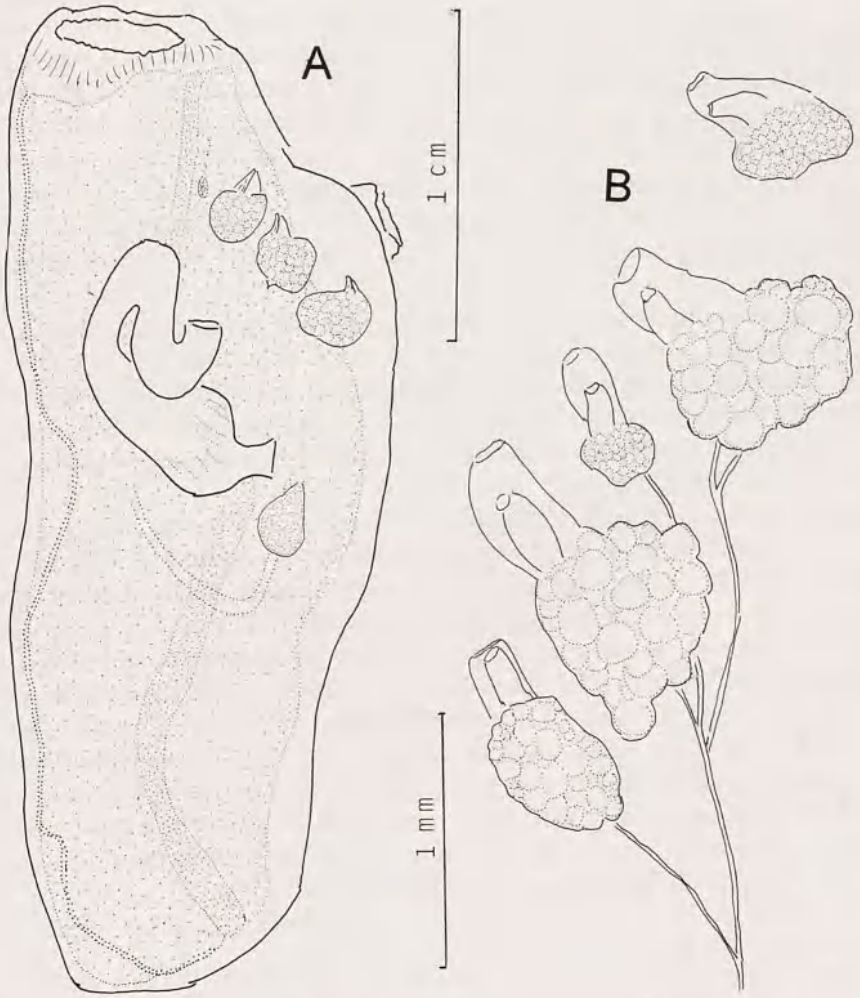

FIG. 5. — *Plurella kottae* Monniot F. & Monniot C. 1996: **A**, internal side of the body; **B**, ovaries.

Source : MNHN, Paris

The heart draws a wide arc at about the three posterior quarters of the body length. It has a dorsal hernia. Against this hernia, and attached to the heart, is a testis mass, below the oesophagus (Figs 2B, 5A). Three to seven ovaries are along an antero-posterior line, with the oviducts directed dorsally (Fig. 2B). Each ovary receives a branch of the long sperm duct with a distal extremity enlarged in an elongated seminal vesicle (Fig. 5B) No velum was observed at the base of the cloacal siphon.

REMARKS. — Among the *Plurella* species with several ovaries, *P. kottae* differs from *P. melanesiae* in a shorter size of the zooids, a more elongated and folded gut and only one testis lobe. *P. elongata* has the cloacal siphon directed posteriorly, a lowest branchial fold, and an open gut loop. Some material collected after 1985 identified by KOTT as *Plurella* sp. from Philippines corresponds to *P. kottae.*

Plurella melanesiae sp. nov.

Figs 1D, 2D, 6

MATERIAL EXAMINED. — **Vanuatu**. *Tongoa Island*: 16°52.43'S, 168°31.88'E, 35 to 45m, dive, G. BARGIBANT/IRD coll. (MNHN P7 Plu 12).

TYPE. — MNHN P7 Plu 12, Vanuatu, Tongoa Island: 16°52.43'S, 168°31.88'E, 35 to 45m.

DESCRIPTION. — In the massive colony (Fig. 1D), the zooids are parallel, 5 to 6 cm long, attached to each other, but cavities of undetermined shape remain between groups of zooids. The tunic is relatively thick when compared to the other species of the same genus. It is embedded with coarse sand except on a part of the right side of the body. There, it is sclerified and brown in colour. It is not attached to the muscular body wall. On the left side of the body, facing the gut and gonads, the tunic is very thickened with encrusted sediment on the external side only. There are no muscles at this level. There is an additional thickening of the body wall and tunic in the shape of an arc parallel but interior to the cardiac arc. This thickening increases towards the dorsal side, including the cardiac hernia and the gonads. This fibrous thickening does not include sediment particles, except on the external layer. The tunic and its incrustation extends at the base of the zooids behind the body wall, probably to anchor the animal in the sediment.

Both siphons are orange, short, directed anteriorly with a thin wall, all damaged. Their rim is neatly toothed, we counted 40 to 50 tentacles in a circle, about 20 of them are long. They are at a short distance from the prepharyngeal band. The body is elongated and the cloacal siphon arises from 1/4 of the branchial sac. On the siphons and the right body side, the body wall contains a brown-orange pigment. The musculature (Fig. 2D) is made of parallel and dense transverse fibres on the right side starting from the anterior part of the branchial sac to the posterior extremity of the body.

The neural ganglion is oval, slightly above the base of the cloacal siphon, in a thickening of the tunic. The neural gland has not been seen. The neural gland channel extends up to the prepharyngeal band, with short branches ended in urns, numerous near the neural ganglion, more sparse towards the distal extremity. The branchial sac has the same structure as in others *Plurella* species, with a long dorsal fold. It is damaged in all specimens which contain several kinds of symbionts : nemerteans, Pontoniidae shrimps, amphipods, polychaetes.

The heart draws a wide half circle at 3/4 of the body length (Figs 2D, 6A, C). It has a dorsal hernia containing an inclusion. Dorsally, applied on the cardiac hernia and inside the thickening of the tunic is the testis (Figs 2D, 6A, D), made of 2 to 6 lobes, more or less close to each other in a bush. These lobes are partly interior and exterior to the cardiac-arc extremity, each having a thin sperm duct. The sperm ducts become parallel and then diverge to join 2 to 4 elongated ovaries (Fig. 6E). The ovaries, included inside the tunic, are placed on a transverse line a the base of the cloacal siphon (Fig. 2D). To each ovary is associated a dilated part of a sperm duct containing numerous spermatozoa. The male and female papillae are joined in each gonad.

The gut forms a loop, more or less closed, very slightly attached to the branchial sac. It is placed in the first half of the body-length (Figs 2D, 6A, C).

REMARKS. — This species differs from all other *Plurella* by its testis divided in several lobes, each of them having an independent sperm duct.

Source : MNHN, Paris

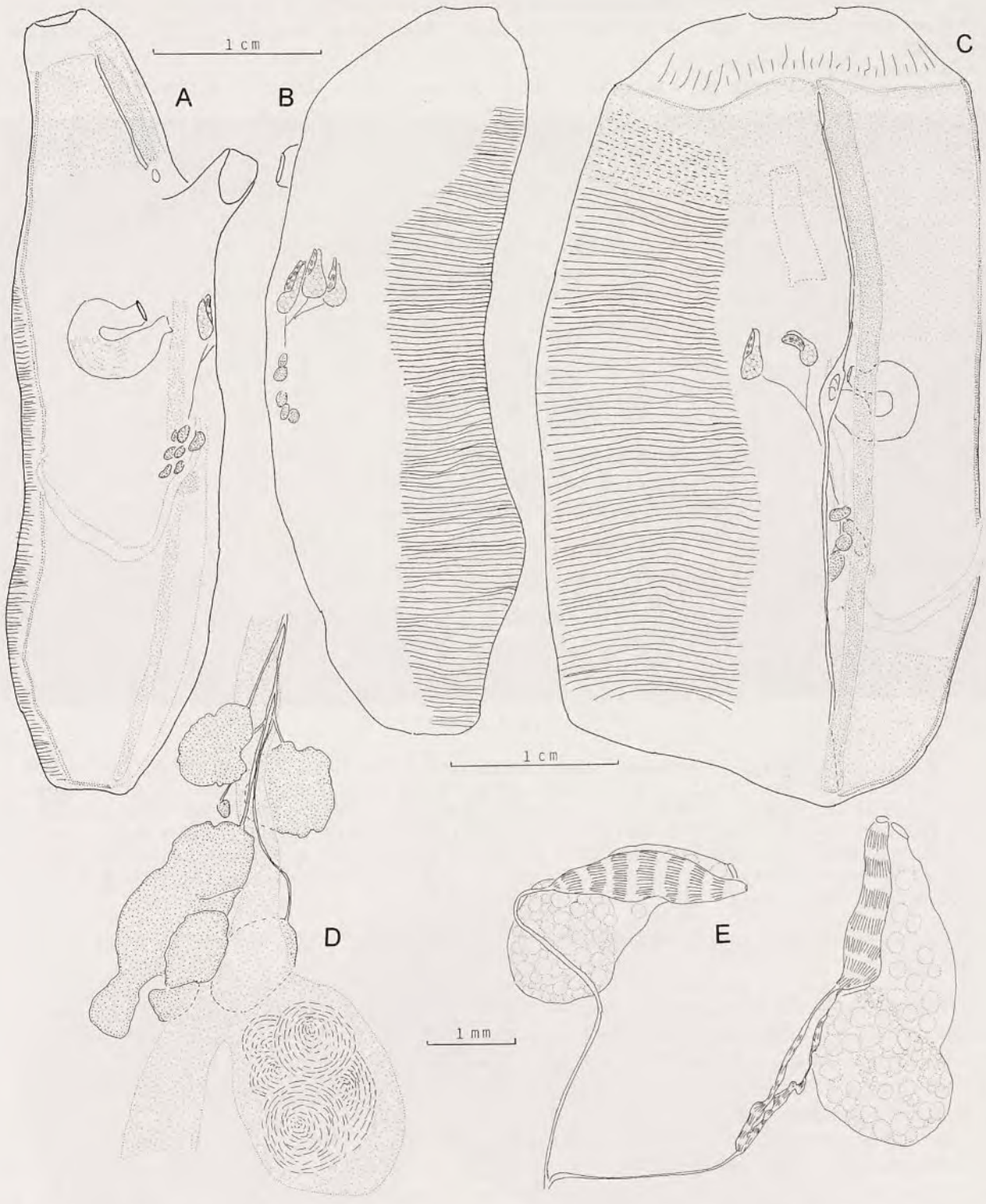

FIG. 6. — *Plurella melanesiae* sp. nov.: **A** and **B**, both sides of the zooid; **C**, internal side of a zooid ventrally opened; **D**, heart diverticulum and testis; **E**, ovaries.

Source : MNHN, Paris

Microgastra granosa (Sluiter, 1904)

Synonymy:
Ascidia granosa Sluiter, 1904: 36.
Microgastra granosa Kott, 1985: 70. — Nishikawa, 1991: 57 and synonymy. — Monniot C. & Monniot F., 1991a: 396.

Material examined. — **Ride des Loyauté**. Musorstom 6: st. CP 419, 20°41.6'S-167°03.7'E, 283 m, 16.02.1989.

The single specimen collected in New Caledonia is too damaged to determine precisely if it corresponds to specimens studied by Kott or Nishikawa, but all these samples are closely related. The presence of only one testis and a single ovary, associated with other characters of the species *Plurella monogyna,* questions the validity of the aggregated condition as a valuable generic character. More specimens will be necessary to solve this question and to finally determine whether there is a true colonial state in the genus *Plurella.*

Genus ***PLURASCIDIA*** nov.

Diagnosis. — Solitary ascidian impregnated with sand. A dorsal tubercle and minute urn-shaped pits along the neural gland channel. Branchial tissue flat with longitudinal vessels and papillae, and with a fold on the left side. Male and female gonads separated linked to the gut loop. No gastric gland. Small excretion vesicles covering the gut. Body musculature transverse.

Type Species. — *Plurascidia marquesana* sp. nov.

Etymology. — Combination of two family names: Plurellidae and Ascidiidae; Gender is feminine.

Plurascidia marquesana g. nov. sp. nov.

Figs 7A, 8-12

Material examined. — **Marquesas Islands**. Musorstom 9: stn DW 1152, Eiao, 7°58.9'S, 140°43.5'W, 85-150 m, 23.08.1997. — Stn CP 1156, Eiao, 7°59.0'S, 140°43.7'W, 80 m, 23.08.1997. — Stn DW 1186, Nuku Hiva, 8°48.1'S, 140°03.5'W, 42-45 m, 26.08.1997. — Stn CP 1187, Nuku Hiva, 8°49.2'S, 140°03.5'W, 25-30 m, 26.08.1997. — Stn DW 1209, Hiva Oa, 9°50.2'S, 139°00.8'W, 85 m, 29.08.1997. — Stn CP 1212, Hiva Oa, 9°49.9'S, 139°02.2'W, 50-80 m, 29.08.1997. — Stn DW 1217, Hiva Oa, 9°44.5'S, 138°49.9'W, 85-87 m, 30.08.1997 (MNHN P7 Plu 2). — Stn CP 1227, Hiva Oa, 9°44.2'S-138°52.5'W, 84-85 m, 30.08.1997. — Stn DW 1230, Hiva Oa, 9°43.6'S, 139°06.6'W, 95-100 m, 31.08.1997. — Stn CP 1239, Hiva Oa, 9°42.2'S, 139°03.6'W, 89-95 m, 31.08.1997.

Type. — Marquesas Islands (Hiva Oa). Musorstom 9, stn 1217, 9°44.5'S, 138°49.9'W, 85-87 m (MNHN P7 Plu 2).

Description. — The individuals are solitary, ovoid, isolated, covered with coarse sand and broken shells. The zooids are not agglomerated but live free on the soft bottom, in large populations. There is no peduncle and no rhizoid. The oral siphon is terminal, the cloacal siphon at mid-distance of the body length. When fixed, the siphon apertures are not visible through the sediment embedding. The individuals measure 2 to 3 cm in length and 1.5 to 2 cm in diameter. All are mature.

The tunic is extremely thin, transparent and colourless. It adheres very slightly to the body wall and can easily be removed except at the edge of the oral siphon. The body wall is thin, perfectly transparent (Fig. 7A). Only small pigment spots are placed at the base of the oral lobes. They probably correspond to sensory organs as thin neural endings leads to them. The oral siphon has 8 large petal-like lobes separated by 8 smaller triangular lobes. Immediately below these lobes is a muscular sphincter. Some longitudinal fibres cross it but do not extend until the tentacular circle. More than 100 tentacles (Figs 8-9) in 3 orders of size (plus buttons) are inserted at the base of a velum containing circular muscle fibres and a blood vessel. Between the oral tentacles and the prepharyngeal

Source : MNHN, Paris

band, the body wall is covered with small papillae. In this thin thickness 2 longitudinal blood vessels issued from the heart extend up to the edge of the oral siphon. One of them follows the endostyle and afterwards the medio-ventral line, the other runs along the neural gland channel and the dorsal line. These vessels are coated with spiral muscle fibres.

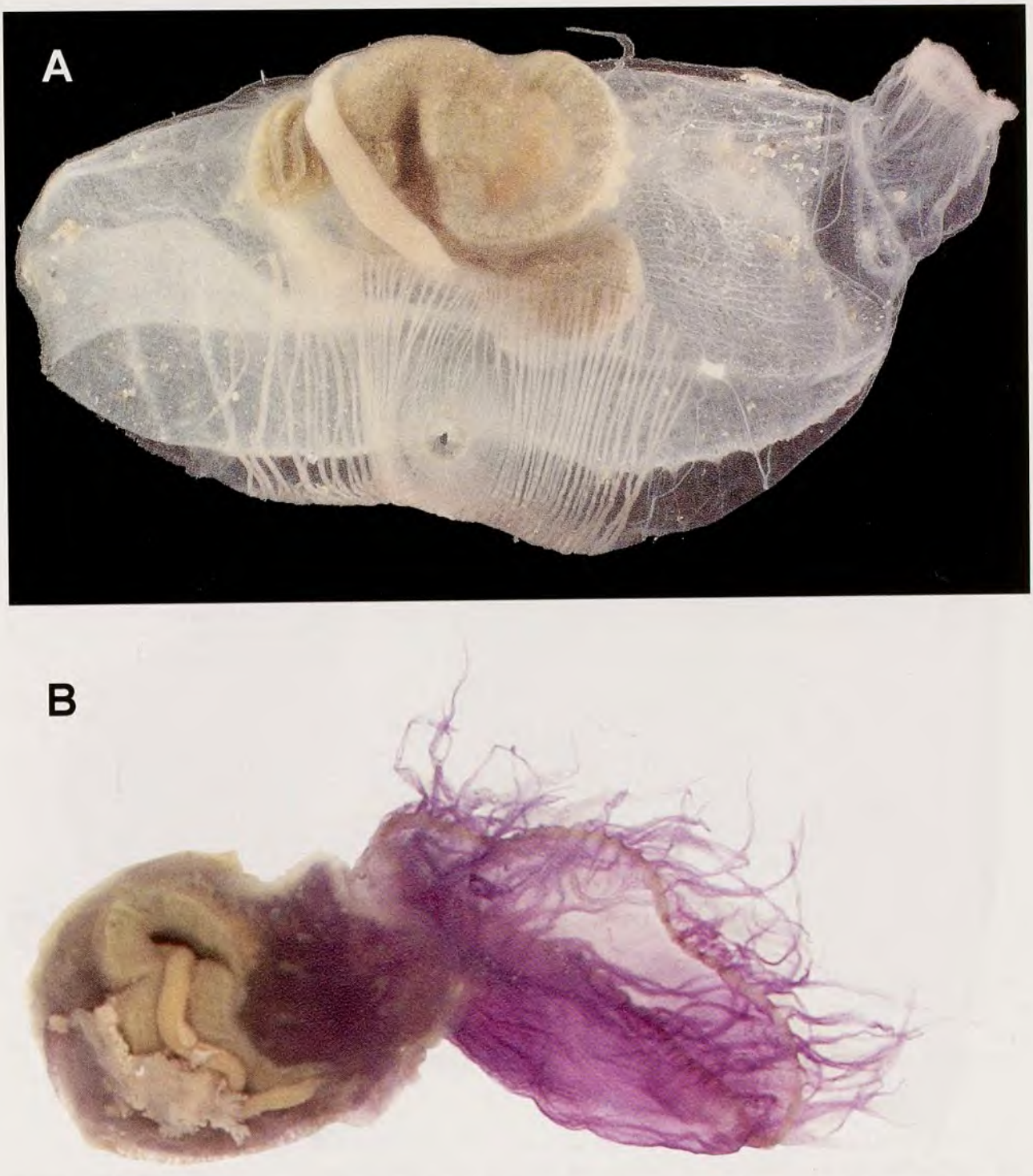

FIG. 7. — **A**, *Plurascidia marquesana* sp. nov., free from tunic; **B**, *Fimbrora calsubia* Monniot C. & Monniot F., 1991, free from tunic, stained with hemalum.

Source : MNHN, Paris

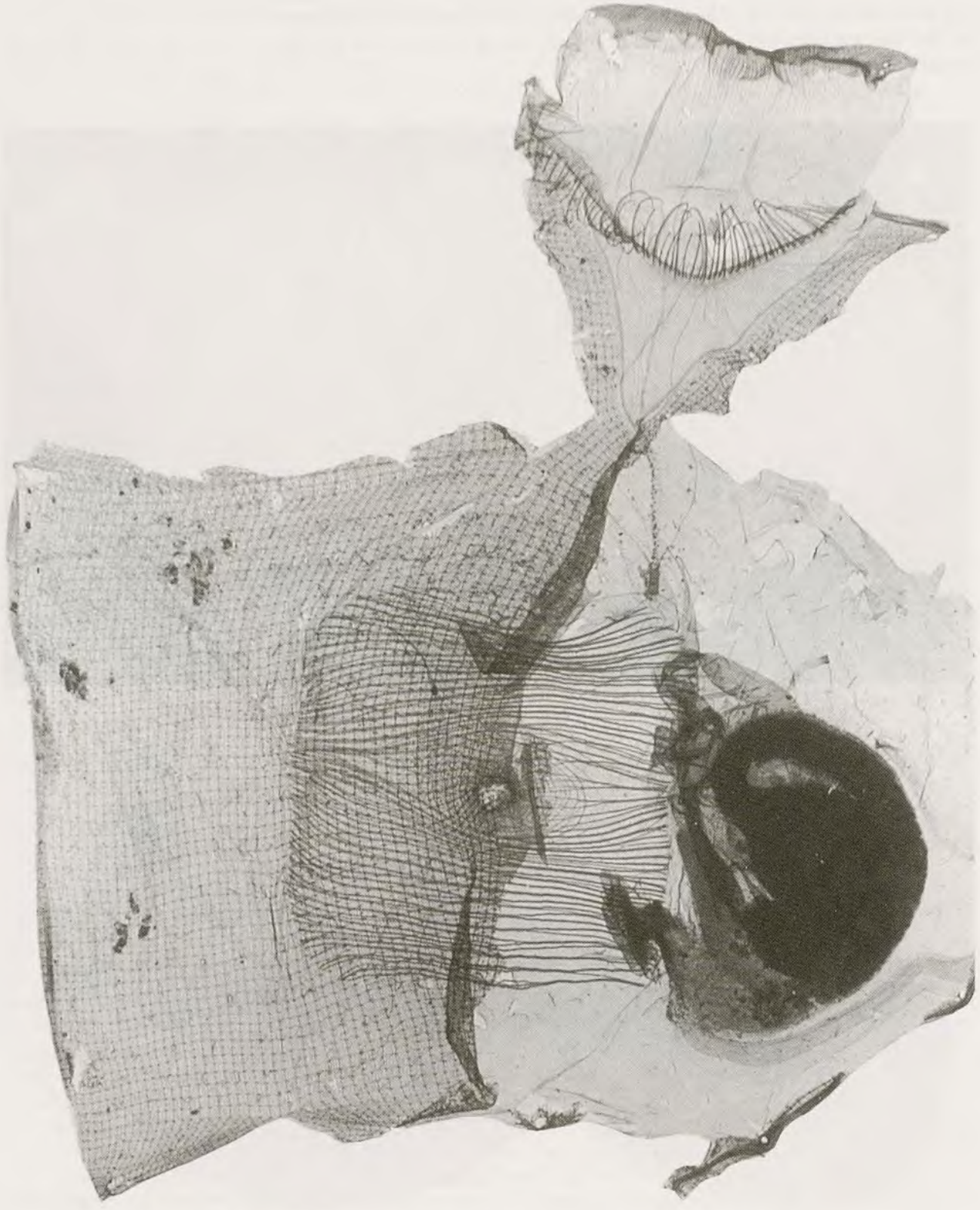

FIG. 8. — *Plurascidia marquesana* sp. nov.: Specimen ventrally opened.

Source : MNHN, Paris

The prepharyngeal band has two blades curved in a V; the posterior blade is prolonged in two parallel crests on the sides of a furrow extending dorsally along 4 to 5 stigmata rows. These 2 crests are posteriorly prolonged by a single dorsal lamina, with a plain margin.

The neural ganglion is rectangular and voluminous (Figs 7A, 9-10). A neural gland is associated to it with an inconspicuous outline. The neural gland channel is straight but bears short numerous branches along its whole length ending in small ciliated urns. A true dorsal tubercle, also urn-shaped, is placed at the bottom of the prepharyngeal V (Fig. 10).

The dorsal part of the body wall is covered with a rectangular field of large muscular fibres, transverse and parallel (Figs 7A, 8, 11C). Not any longitudinal fibre crosses them. The cloacal siphon opens in the middle of the field. It is edged by 6 petal-like lobes and circled by a muscular sphincter. Some short radial fibres cross the sphincter but do not overpass the siphon level (Figs 7A, 8).

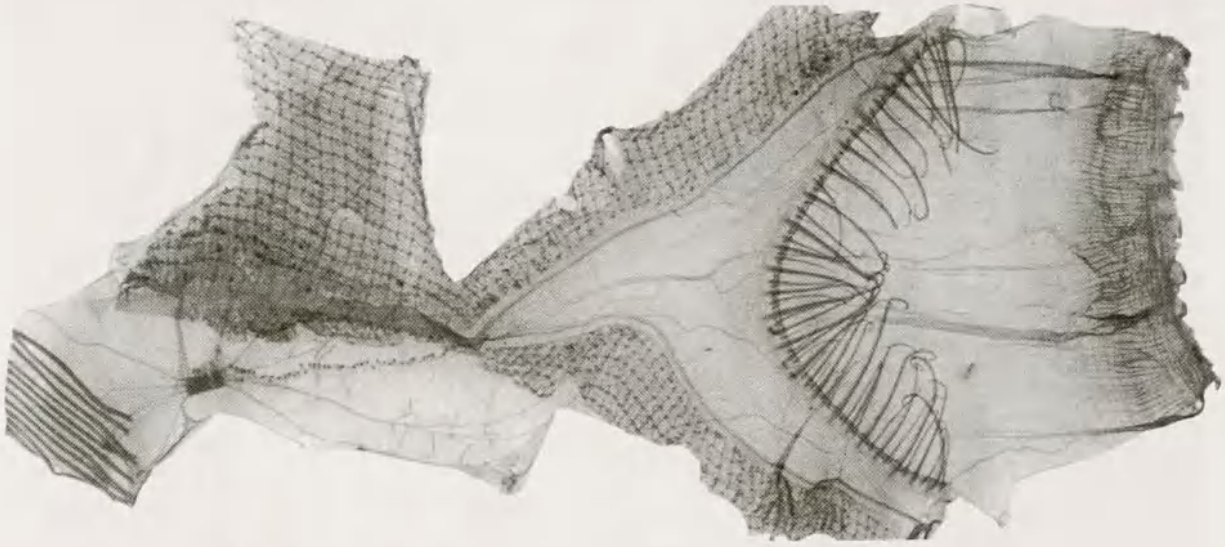

FIG. 9. — *Plurascidia marquesana* sp. nov.: Neural area and oral siphon.

FIG. 10. — *Plurascidia marquesana* sp. nov.: Neural ganglion, neural gland and its multiple openings, dorsal tubercle, dorsal blood vessel.

The branchial sac is only attached to the body wall along the endostyle and by tissular strips particularly thick at the level of the anterior part of the dorsal lamina. The branchial sac begins against the prepharyngeal band. It is flat anteriorly, but a fold progressively appears on the left side and becomes higher at the bottom of the branchial

Source : MNHN, Paris

sac (Fig. 12). It is hold by strips and a soldering at the level of the retropharyngeal line. The branchial sac is soldered to the rectum. In a specimen of median size, we counted 48 longitudinal vessels on the left side and 52 on the right, and about 80 rows of stigmata. The longitudinal vessels only begin at the first transverse vessel or first parastigmatic vessel, but are not prolonged in the space between the prepharyngeal band and the first stigmata row as they do in the *Plurella* species. The longitudinal vessels bear ciliated papillae at the crossings with the transverse and parastigmatic vessels when they exist (Fig. 12). The endostyle has no peculiar characters. It ends at the bottom of the branchial sac against the branchial fold (Figs 7A, 8A, 11A-B) .

The digestive tract occupies a large part of the left side. It is full in all dissected animals (Fig. 7A). The oesophagus opens at 4/5 of the body length with a papillated internal wall. It is narrow and short. The oval stomach has some low longitudinal folds, 4 to 5 on each side (Fig. 7A), but its wall remains thin. A closed intestinal loop is narrowed by a neat constriction (Fig. 11D). A last segment, widened and with a specially thin wall constitutes the rectum. The anus is very small on the dorsal part of the rectum (Fig. 11C). The oesophagus, stomach, and first intestinal loop are covered with minute vesicles, each containing a concretion, a structure frequent in the Ascidiidae family.

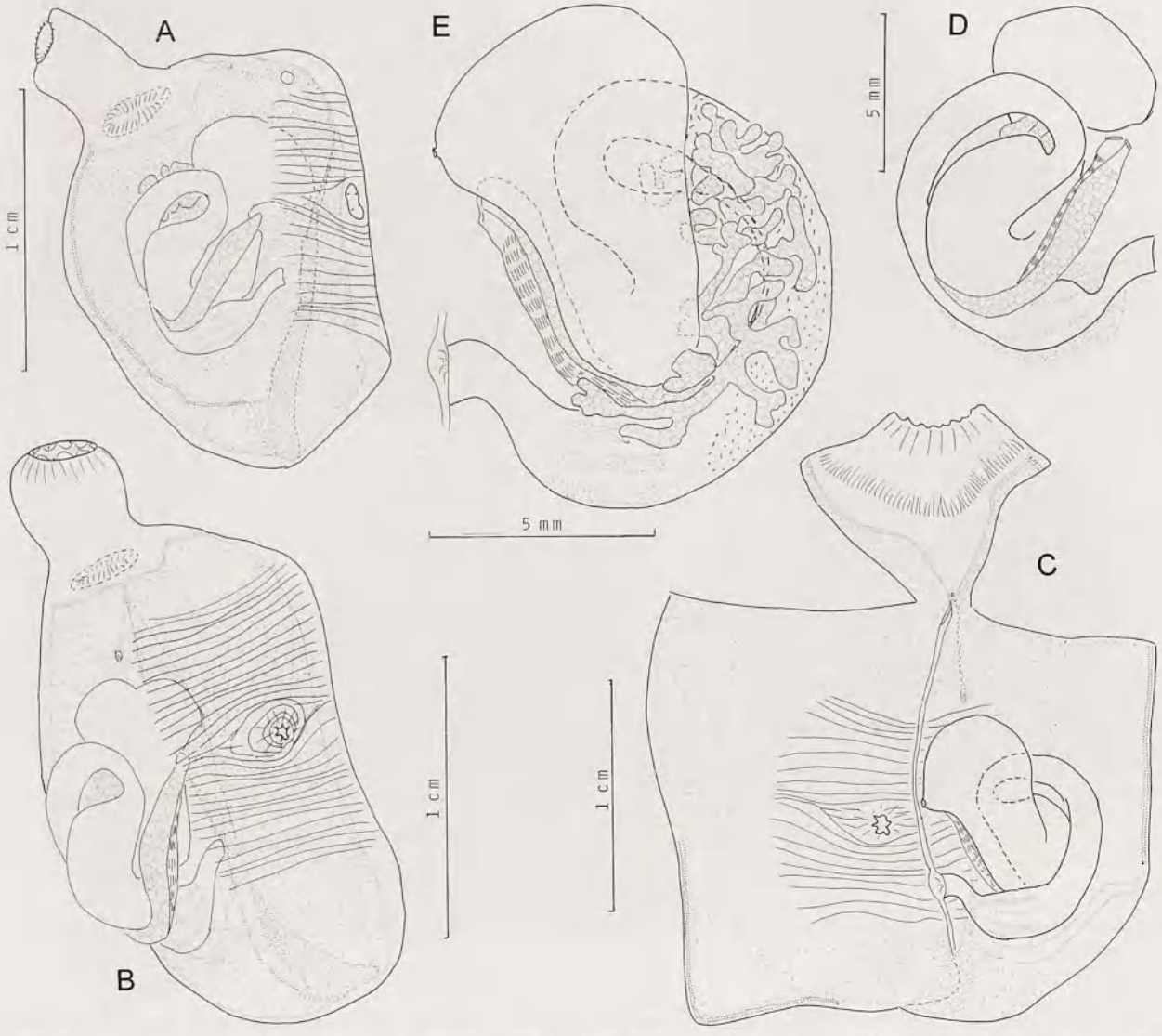

FIG. 11. — *Plurascidia marquesana* sp. nov.: **A** and **B**, left side of two specimens; **C**, specimen opened ventrally; **D**, external side of the gut; **E**, internal side of the gut and gonads.

Source : MNHN, Paris

The internal side of the gut (except the rectum) is covered by the gonads (Fig. 11E). The testis and ovary make a ramified network of undefined outline. The oviduct is long, wide and straight, filled with eggs running along the oesophagus, stomach and rectum (Figs 7A, 11D). It opens by a large papilla with a toothed margin. The sperm duct is dilated by the spermatozoa, attached to the oviduct and it opens at the same level.

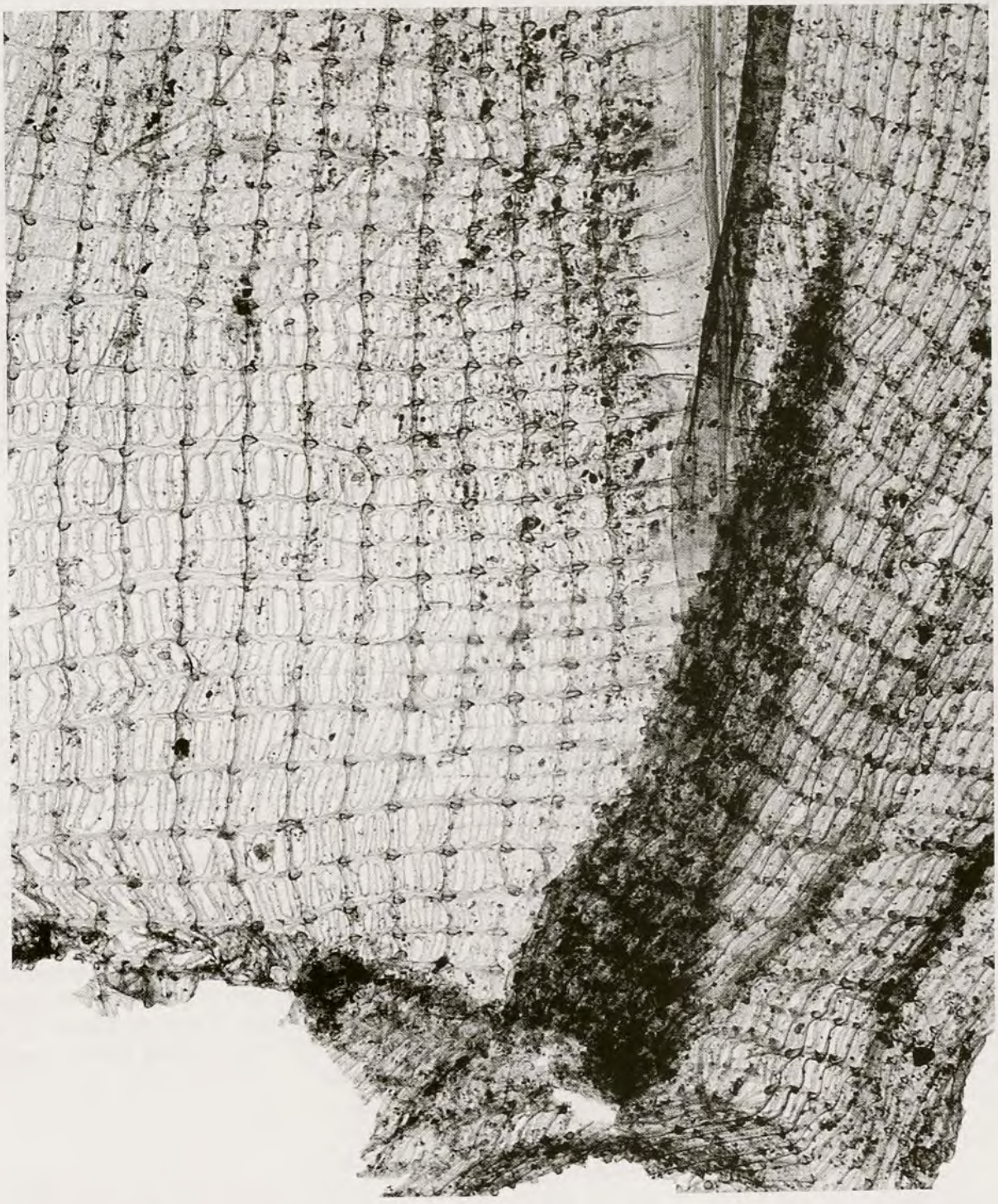

FIG. 12. — *Plurascidia marquesana* sp. nov.: Posterior dorsal part of the branchial sac.

Source : MNHN, Paris

The heart forms a large arc, first encircling the posterior part of the gut and then reaching the endostyle. The cardiac cells are in longitudinal lines and draw thin ridges after staining. A diverticulum in hernia placed against the stomach contains a concretion. A complex blood system of large vessels starts from the heart. These large vessels are lined by helicoïdal muscular fibres. The largest vessels are under the endostyle and medio-dorsal, and directed towards the gut and gonads. These vessels are similar to those described in the species *Fimbrora calsubia* Monniot C. & Monniot F., 1991.

REMARKS. — *Plurascidia marquesana* has in common with the Plurella species an oral siphon with lobes more or less internally folded when contracted lined interiorly with minute papillae; numerous oral tentacles in one circle; many accessory urn-shaped openings along the length of the neural gland channel; a branchial sac with numerous longitudinal vessels, papillae, and a fold on the left side; a heart in a long tube in an arc with a hernia containing a concretion; a musculature made of transverse parallel bundles restricted to a limited area of the body wall.

Many differences can be noted with the *Plurella* species these characters bringing *Plurascidia marquesana* nearer to the Ascidiidae : the presence of a dorsal tubercle; the longitudinal vessels which do not reach the top of the first row of stigmata; the gonads male and female linked to the gut; the presence of renal vesicles covering the intestine.

The new species *Plurascidia marquesana*, though different in aspect, possesses characters common to *Fimbrora calsubia* Monniot C. & Monniot F., 1991, a deep species assigned to the Ascidiidae family. The genera *Fimbrora* and *Plurascidia* have in common the general branchial structure, the gonads linked to the digestive tract, the structure of the vascular system and the absence of muscles on the left side of the body. Both genera have a muscular sphincter at the base of the oral tentacles and 2 large longitudinal blood vessels, dorsally and ventrally, in the oral siphon. These 2 genera differ by the structure of the tunic, the branchial fold present in *Plurascidia,* the carnivorous diet in *Fimbrora*, filter-feeding in *Plurascidia*. Only one dorsal tubercle in a slit exists in *Fimbrora,* when multiple urn-shaped apertures are found in *Plurascidia*. Finally *Fimbrora* has an accessory gland on the stomach.

Fimbrora calsubia Monniot C. & Monniot F., 1991

Fig. 7B

Fimbrora calsubia Monniot C. & Monniot F., 1991: 383, figs 1-6. — MONNIOT C., 1993: 356.

The single species in this genera was collected at 1865 m off New Caledonia and at 1020 m near Tanimbar Island in Indonesia. The anatomy of these specimens is remarkably constant and differs in numerous characters from the Plurellidae and the new genus *Plurascidia.*

The tunic is not embedded with sediment but transparent, thick on the ventral side where it has a cartilaginous consistency. The oral siphon is extremely developed (Fig. 7B), basket-like, but the mouth is narrow in the bottom of the siphon equipped with a strong sphincter. The dorsal and anterior part of the branchial sac is attached to the body wall, and it is in this thick tissue that the neural gland channel spreads, its single opening being located in the dorsal V of the prepharyngeal band. The stomach with some longitudinal folds is covered by a voluminous gland in the shape of a cauliflower (Fig. 7B). The male and female gonads lobes are separated but lined along the internal side of the intestine, the oviduct and sperm duct parallel, long, are applied against the intestine. The gut and gonads are included in the body wall.

Nevertheless, some common characters with the Plurellidae and the genus Plurascidia have to be emphasised, the structure of the branchial tissue, with longitudinal vessels topped by papillae at the crossings of the transverse and parastigmatic vessels. A dorsal lamina in a plain membrane. The heart in the shape of a long tubular arc at the posterior part of the body. The musculature limited to one side of the body wall. *Fimbrora* has also in common with *Plurascidia* the muscular helicoidal fibres found in the main blood vessels.

ACKNOWLEDGMENTS

We thank the Queensland Museum for the loan of *Plurella* specimens. We are very indebted to Todd NEWBERRY for his suggestions and advice regarding the English version of this paper.

Source : MNHN, Paris

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Source : MNHN, Paris

Source : MNHN, Paris

14

Pisces Gadiformes: Grenadier Fishes of the New Caledonian Region, Southwest Pacific Ocean. Taxonomy and Distribution, with ecological notes

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ABSTRACT

We reported in an earlier paper the great species richness of the grenadier fauna (families Bathygadidae and Macrouridae) from recent bathyal trawl collections made mainly during MUSORSTOM cruises in the New Caledonian region. Here we add information from further samples to complement earlier taxonomic findings, and descriptions of 2 new species, together with comments on species, distribution and ecology. Thus a total of 2055 specimens from 221 samples examined representing 20 genera and 63 species were found to have closest similarity in composition with New South Wales, Western Australia and New Zealand. As expected, dissimilarity increased with distance from New Caledonia. Four genera dominated in species richness: *Caelorinchus* (17), *Hymenocephalus* (8), *Nezumia* (5) and *Ventrifossa* (6), comprising 2/3 of the total fauna. The generic make-up of the faunas closest to New Caledonia were most consistent with that region; proportions varied radically from there in the more distant regions investigated. Bathymetrically, the smaller trawls of the MUSORSTOM surveys collected grenadiers over a range of tows shallower than that reflected by the

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Source : MNHN, Paris

commercial gear used on the HALIPRO 2 cruise, with a generally smaller size of fish sampled. Co-occurrence of grenadier species within similar depth strata on the slope was remarkably high, with only two of the 63 species not represented, at least over part of their depth range, in the upper 1600 m. Species richness peaked at 37 in both the 700 and 800 m strata, although it did not drop below 20 across the depth range 400-1100 m and reduced substantially only deeper than 1400 m.

RÉSUMÉ

Pisces Gadiformes: Grenadiers de la région néo-calédonienne, Sud-ouest Pacifique. Taxonomie, distribution et notes écologiques.

Nous avons attiré l'attention dans un travail précédent sur la grande richesse en espèces de la faune des grenadiers (familles Bathygadidae et Macrouridae) récoltée récemment dans la région néo-calédonienne, au moyen de chalutages dans la zone bathyale, principalement au cours des campagnes MUSORSTOM. Ici nous donnons des informations complémentaires fournies par de nouvelles récoltes, décrivons deux nouvelles espèces et fournissons des données sur la distribution des espèces et leur écologie. Ainsi un total de 2055 spécimens provenant de 221 récoltes, renfermant 20 genres et 63 espèces, ont montré que la composition de cette faune est la plus proche de celles de la Nouvelle-Galles du Sud, de l'Australie de l'Ouest et de la Nouvelle-Zélande. Comme on pouvait le prévoir, la dissimilarité s'accroît avec l'éloignement de la Nouvelle-Calédonie. Quatre genres prédominent en ce qui concerne le nombre d'espèces: *Caelorhynchus* (17), *Hymenocephalus* (8), *Nezumia* (5) et *Ventrifossa* (6), représentant les 2/3 de la faune totale. La composition en genres des faunes des régions les plus proches de la Nouvelle-Calédonie est homogène; elle varie par contre nettement pour les zones plus éloignées. D'un point de vue bathymétrique, les récoltes des campagnes MUSORSTOM faites avec des petits chaluts ont capturé des grenadiers à des profondeurs inférieures à celles observées durant la campagne HALIPRO 2 faite avec un chalut commercial; de même, les tailles des grenadiers capturés alors ont été inférieures à celles des captures faites lors d'HALIPRO 2. Il n'y a que deux espèces sur les 63 recensées qui ne soient pas représentées, au moins pour une partie de leur répartition bathymétrique, dans la tranche 300-1900 m, ce qui souligne le nombre élevé d'espèces de grenadiers susceptibles de se rencontrer ensemble sur la pente, dans une même tranche bathymétrique. La diversité maximale en espèces a culminé pour les tranches des 700 et 800 m où 37 espèces ont été relevées; cette diversité n'est pas tombée à moins de 20 entre 400 et 1100 m et ne s'est subtantiellement réduite qu'au delà de 1400 m.

INTRODUCTION

Exploratory collections at bathyal depths of the Exclusive Economic Zone of New Caledonia, in the Southwest Pacific, have been carried out by the Institut de Recherche pour le Développement (IRD - formerly ORSTOM) since 1984 (RICHER DE FORGES, 1990; RICHER DE FORGES & MENOU, 1993; GRANDPERRIN *et al.*, 1997; SÉRET, 1997). The greater part of these collections were deposited in the Muséum national d'Histoire naturelle, Paris, where they were sorted into family groups by Bernard SÉRET and allocated to specialists to work up. IWAMOTO & MERRETT (1997) studied the astonishingly diverse grenadier fauna, families Bathygadidae and Macrouridae, and recorded 49 species in 16 genera from the samples collected up to 1993. Now more recent collections made during three cruises by ORSTOM off Vanuatu (MUSORSTOM 8), New Caledonia (BATHUS 1), and the Norfolk and Loyalty Ridges (HALIPRO 2) have added 14 spp. and 4 genera, raising the total to 63 species (two listed as 'indeterminate' in the previous paper) in 20 genera.

The New Caledonia group of islands is an emerged portion of the Norfolk Ridge, a geosyncline which extends southwards towards New Zealand. While some of the collections of grenadiers were made in the vicinity of New Caledonia and along the Norfolk and Loyalty Ridges, others originated from an extensive area to the west on the Chesterfield and Bellona Banks, and Fairway and Lord Howe Rises. All these were located on the main Indo-Australian Plate, but separated by the New Hebrides Trench from another group of samples taken around the Matthew and Hunter volcanoes and Vanuatu Islands, also on this Plate. The tectonically complicated North Fiji Basin and the Vitiaz Trench separated these from the most easterly group of samples, which were taken around Wallis and Futuna Islands on the Pacific Plate (Fig. 1 a). The complexity of the region overall is briefly described by RICHER DE FORGES & MENOU (1993). Two hundred and twenty-one samples contained grenadiers from a total of 970 (Table I) taken between 280 and 3690 m by a variety of towed gears. All these grenadier samples were kindly made available to us and were taken between 280 and 2105 m depth, but were concentrated in the 300-1400 m zone.

Source : MNHN, Paris

The purposes of this paper are (1) to report on additional grenadier collections resulting from these three cruises, (2) discuss aspects of the distribution of the overall grenadier fauna arising from this and the earlier paper (IWAMOTO & MERRETT, 1997) and (3) record notes on the population ecology of a few of the more abundant species.

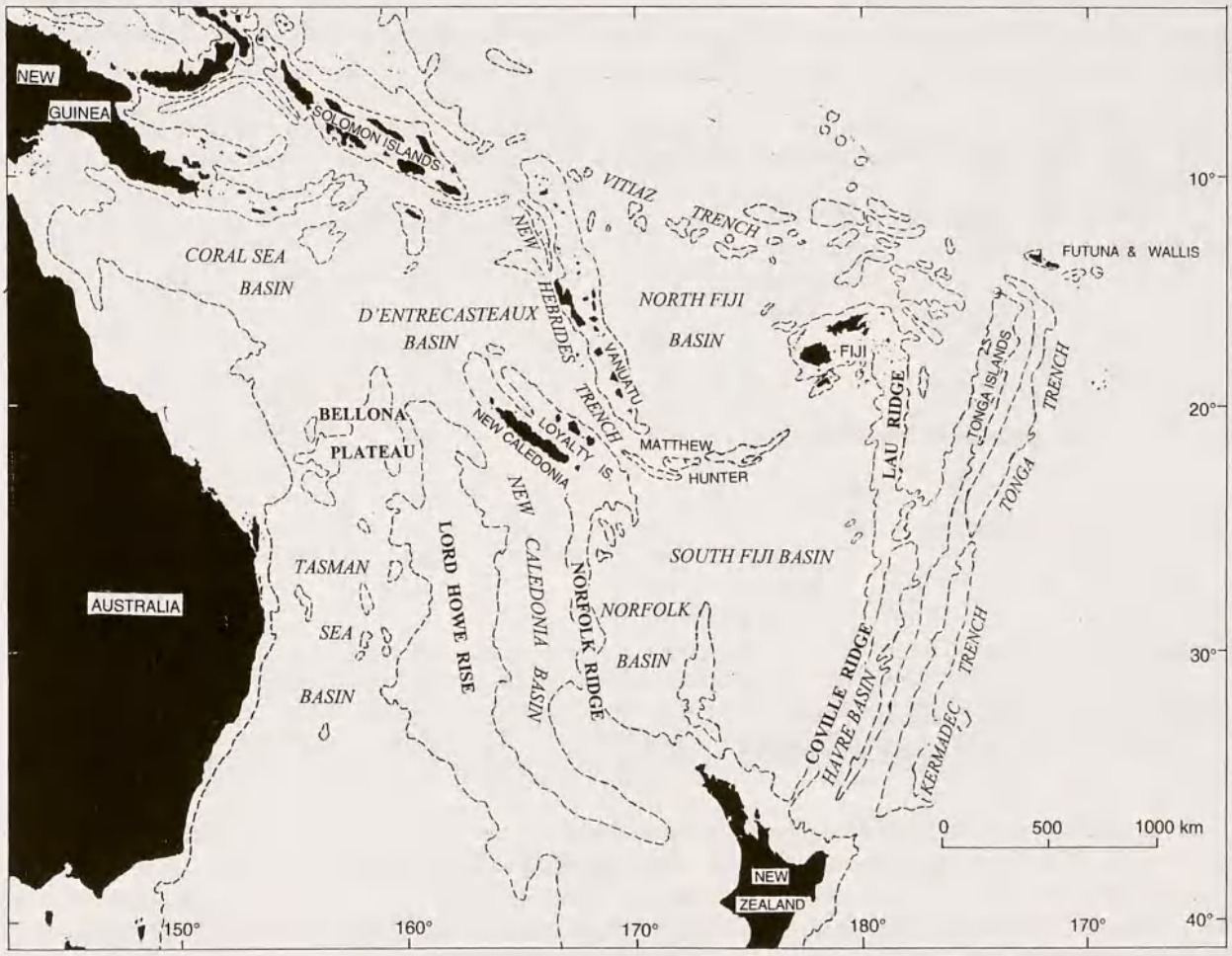

FIG. 1 a. — General chart of area.

MATERIALS AND METHODS

A variety of gear was used to collect the samples. The majority of samples containing grenadiers were taken with a beam trawl (CP - 127 tows) and an orange roughy bottom trawl (ORBT - 65), supplemented by an American shrimp trawl (CC - 19), a Waren dredge (DW - 7) and a Charcot dredge (DC - 3; Table 1). The dimensions of these gears vary considerably and are given for the CP (mouth opening 4 m by 0.4 m) in FOREST (1976), RICHER DE FORGES (1990), for the ORBT (mouth opening 26 m by 8 m) in GRANDPERRIN *et al.* (1997), for the CC (mouth opening ca 9 m by ca 1.5 m) in FOREST (1976), the DW (mouth opening 0.71 m by 0.28 m) in RICHER DE FORGES (1990) and for the DC (mouth opening 0.8 to 1.2 m by 0.35 m) in RICHER DE FORGES (1990). The complete lists of the station data are given by RICHER DE FORGES (1990), GRANDPERRIN & LEHODEY (1992), LEHODEY *et al* (1993), RICHER DE FORGES & MENOU (1993) and GRANDPERRIN *et al.* (1997). Depth of the capture was taken as the mid-point of the soundings recorded at the start and finish of the tow. The variation in

Source : MNHN, Paris

the effectiveness of the gears used in sampling active species like grenadiers (see below - pp. 730-731, table1), together with the lack of accurate times of arrival and departure of the gear to and from the seabed, prevented meaningful analysis of fish density or biomass. Thus in considering species distribution, the species presence/absence approach was the only one tenable. Catches were referred to the sample mid-depth soundings and treated by 100 m bathymetric strata. In this connection, it should be noted that many of the ORBT hauls were down-slope tows from off the tops of seamounts. Hence the depth limits of individual tows were sometimes in excess of 400 m. In these cases, normalizing to mid-depth values introduced uncertain actual capture depths of different species which should be recognized as being implicit in the results.

TABLE 1. — Summary of sample collections by gear and area: (**a**) overall collection, (**b**) samples containing grenadiers. (CP - beam trawl; ORBT - orange roughy bottom trawl; CC - shrimp otter trawl; DW - Waren dredge; DC - Charcot dredge).

(a) Overall sampling:-

Gear:	**CP**	**ORBT**	**CC**	**DW**	**DC**	**Total**
Area - I	34	11	6	59	18	128
II	162	93	22	291	10	578
III	83		6	59		148
IV	12		2	102		116
Total number of hauls per gear	**291**	**104**	**36**	**511**	**28**	**970**

(b) Hauls with grenadiers:-

Gear:	**CP**	**ORBT**	**CC**	**DW**	**DC**	**Total**
Area - I	8	9	6	1	3	27
II	65	56	7	3		131
III	39		4	1		44
IV	15		2	2		19
Total number of hauls with grenadiers	**127**	**65**	**19**	**7**	**3**	**221**
Percent of all hauls with grenadiers	43.6	62.5	52.8	1.4	10.7	22.8

Geographically, samples containing grenadiers were allocated to one degree square units, which themselves were distributed into four regional groupings (Fig. 1b). Group I catches were the most westerly in location on the Indo-Australian Plate, taken from the area of the Chesterfield and Bellona Banks and the Fairway and Lord Howe Rises. East of this were the catches taken on the slopes around New Caledonia and along the Norfolk and Loyalty Ridges (Group II). Group III catches were from northeastward of the Group II stations, beyond the subduction zone where the Indo-Australian Plate sinks below the Pacific Plate (RICHER DE FORGES, 1990), along the western and southern slopes of the Vanuatu Islands and the Matthew and Hunter volcanoes. Considerably remote from Group III, again in the northeasterly direction, the Group IV catches were taken in the vicinity of Wallis and Futuna Islands on the Pacific Plate.

The samples were fixed in saline formol and later transferred into 70% industrial ethanol. Length measurements were made on the preserved material in accordance with IWAMOTO (1970) and IWAMOTO & WILLIAMS (1999). Where possible, stomachs were opened and preliminary assessment of their contents made according to broad groupings of recognizable organisms. At the same time these specimens were sexed and ovarian maturity was assessed according to MERRETT (1970).

Institutional abbreviations follow LEVITON *et al.* (1985) and LEVITON & GIBBS (1988). The reader is referred to IWAMOTO & MERRETT (1997) for discussion and explanation of the taxonomic section. Because this second paper is intended for use with the first, we have omitted information in the taxonomic section that has already been presented in the first article. Thus, the diagnoses, descriptions, and synonymies are omitted, except for species not previously treated. Synonymies may be included, however, for references to recent articles. Size and distribution are also not included in the species accounts unless additional information has been obtained.

Source : MNHN, Paris

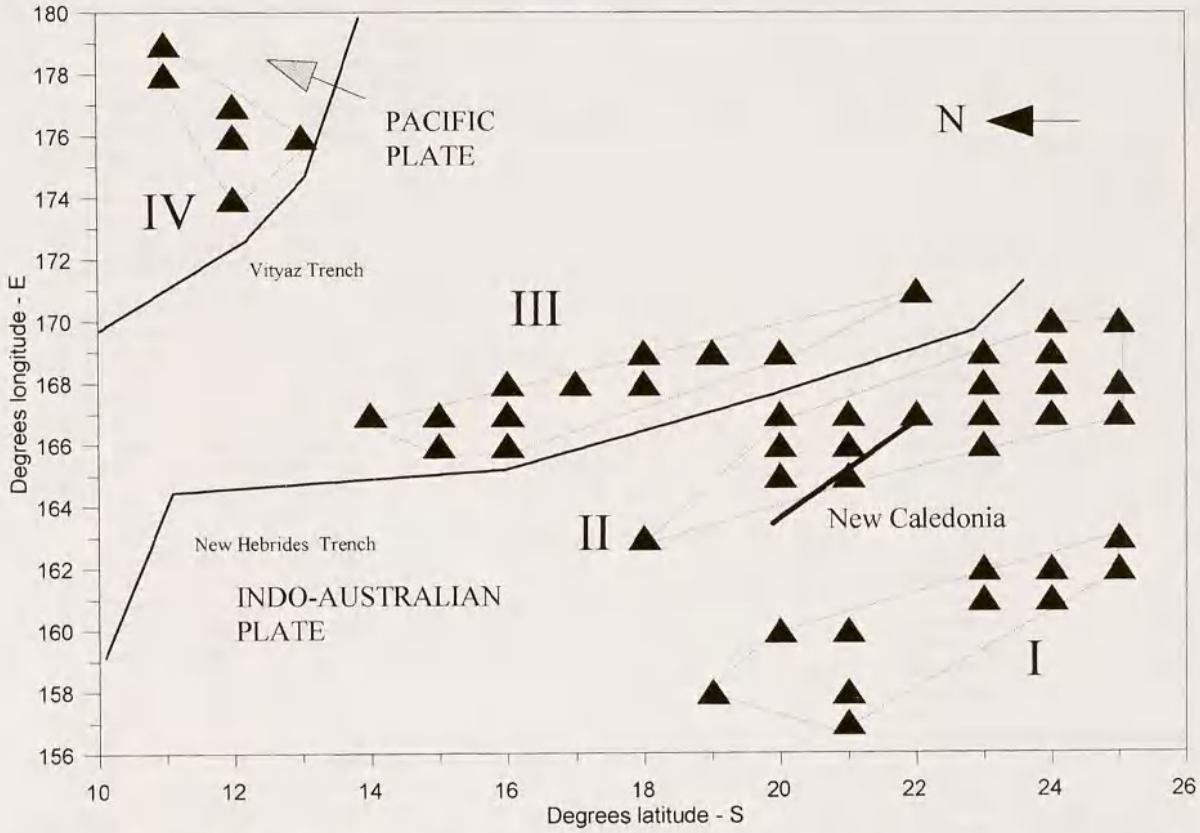

FIG. 1 b. — Schematic representation of the 48 degree squares occupied by the 221 stations containing greanadiers by region (I - IV). Sampling regions I (Chesterfield and Bellona Banks, Fairway and Lord Howe Ridges - 27 samples) and II (New Caledonia, Norfolk and Loyalty Ridges - 131) lie on the main Indo-Australian Plate and are separated from region III (Matthew and Hunter volcanoes and Vanuatu Is. - 44) in the tectonically complicated North Fiji Basin by the New Hebrides Trench. Region IV (Wallis and Futuna Is. - 19) alone lies on the Pacific Plate.

RESULTS

A total of 2055 specimens representing 20 genera and 63 species of grenadiers occurred in the 221 samples examined from 48 different degree squares in the area (Table 2). A little more than half the species richness was contributed by the genera *Caelorinchus* (17 species), *Hymenocephalus* (*sensu lato*) (8), *Ventrifossa* (6) and *Nezumia* (5). Forty-two (66%) of these species occurred entirely or in part within the 400-800 m depth range (Table 2). A little more than half the species (35) were represented in the catches by eight specimens or less, while 14 species were represented by >32 specimens (Fig. 2). Nineteen species were found to be undescribed hitherto (30% - IWAMOTO & MERRETT (1997) and see below). Representation of new species in the catches was not restricted to individual records (IWAMOTO & MERRETT, 1997 - their Fig. 3). Only four of these were represented by singletons in the overall collection, reflecting the novelty of the deep ichthyofauna of the area. Indeed, the most abundant species sampled was new (*Hymenocephalus megalops* - 390 specimens from 26 stations; Table 2), together with another, *Ventrifossa paxtoni*, (88 specimens, 29 stations) and a third, *Lucigadus acrolophus*, (26 specimens, 7 stations).

TABLE 2 (following pages). — Synopsis of grenadier representation, giving distribution per area, depth and frequency of capture. [Distr type - Indicates species regional affinities discussed in the section on zoogeography - **A**, endemic; **B**, broad northern tropical; **C**, southern temperate; **D**, widespread, global or multiple-ocean-basin representatives. **Tot No**, total number of specimens collected per area; **F**, number of tows from which 'Tot No' were sampled (*No. hauls/area* given in these columns provides a measure of the relative effort per area, from Table 1).]

Source : MNHN, Paris

			AREA I Chesterfield, Bellona, Fairway, Lord Howe Rise					AREA II New Caledonia, Norfolk Ridge, Loyalty				
		Distr type	Tot No	Depth (m)	Lat Deg S	Long Deg E	F	Tot No	Depth (m)	Lat Deg S	Long Deg E	F
No. hauls/area							***128***					***578***
SPECIES												
Bathygadidae												
Bathygadus	*cottoides*	C	**5**	1060--1256	24--25	161--162	4	**7**	1030--1320	25	167	1
	spongiceps	D	**4**	964--1233	23--24	161--162	3	**49**	885--1564	24--25	162--170	15
Gadomus	*introniger*	B						**2**	790--1160	21--25	165--167	2
	sp. indet.		**1**	785	21	160	1					
Macrouridae												
Caelorinchus	*acutirostris*	B						**2**	425--530	21--22	165--167	2
	anatirostris	B	**4**	607--774	19	158	3	**5**	450--844	20--22	165--167	3
	argentatus	B						**15**	415--447	22	167	3
	celaenostomus	C						**10**	625--1340	23--25	167--169	6
	cingulatus	B						**6**	480--660	18--20	165--167	3
	cylindricus	A						**1**	735	24	168	1
	kermadecus	C	**18**	964--1357	23--25	161--163	6	**72**	800--1450	23--25	167--170	15
	melanobranchus	A						**5**	415--502	22--23	167	4
	mycterismus	C						**1**	1105--1360	25	170	1
	parallelus	C	**4**	421--1124	19--25	158--162	4	**1**	981	23	168	1
	platorhynchus	B						**2**	685--831	21--23	166--169	2
	semaphoreus	B						**1**	485	18	163	1
	sereti	A	**4**	421--774	19	158	2	**9**	450--844	20--24	165--166	6
	shcherbachevi	C						**4**	804--835	24	169--170	2
	spathulatus	C	**21**	607--785	19--21	158--160	6	**10**	580	18	163	1
	supernasutus	C						**1**	690	25	168	1
	trachycarus	C						**1**	1350	24	167	1
Cetonurichthys	*subinflatus*	D						**1**	1440	24	168	1
Cetonurus	*crassiceps*	D	**2**	1121	25	162	1	**11**	697--1340	23--25	162--170	5
Coryphaenoides	*rudis*	D	**1**	1336	25	163	1	**2**	1349--1862	23--24	167--168	2
	striaturus	C	**1**	1244	24	162	1	**7**	1132--1555	23--25	166--168	7
	dossenus	C						**2**	856--1450	23-24	168	2
Haplomacrourus	*nudirostris*	D										
Hymenocephalus	*adelscotti*	C										
	aterrimus	D						**23**	820--1348	23--25	166--170	6
	gracilis	D	**1**	500	20	160	1	**9**	415--580	18--24	163--168	5
	kuronumai	B	**6**	650--710	19	158	4					
	longibarbis	C						**42**	425--800	18--24	163--168	17
	megalops	B	**190**	675--790	19--21	158--160	7	**19**	302--700	18--24	163--168	4
	nascens	B	**58**	675--842	19--21	158--160	6	**73**	302--850	18--23	165--168	11
	nesaeae	A										
Kumba	*punctulata*	B						**1**	530	24	168	1
	musorstom	A						**1**	1098--1480	25	168	1
Kuronezumia	*bubonis*	D										
Lucigadus	*acrolophus*	A						**22**	415--450	22--23	167	5
	microlepis	B						**86**	395--880	18--24	163--168	26
Macrosmia	*phalacra*	D										
Malacocephalus	*laevis*	D	**1**	575	19	158	1	**2**	575--590	23--24	168	2
Mataeocephalus	*acipenserinus*	D	**2**	842	19	158	1	**1**	775	21	166	1
	adustus	B										
	sp.	B	**3**	421--970	19--21	157--158	2	**3**	775	21	166	1
Nezumia	*aspidentata*	A	**1**	710	19	158	1					
	cliveri	A						**2**	817--1160	24--25	167--170	2
	coheni	C	**1**	1121	25	162	1	**5**	705--1480	23--25	167--170	5
	propinqua	D	**11**	774--1130	19--24	158--162	3	**12**	405--800	21--24	165--170	8
	spinosa	D						**3**	640--817	24--25	168--170	3
Pseudonezumia	*parvipes*	B						**1**	2105	22	167	1
	pusilla	D						**1**	1815	21	167	1
Sphagemacrurus	*pumiliceps*	D	**6**	842	19	158	1	**24**	786--1815	21--25	165--168	6
Squalogadus	*modificatus*	D	**13**	1118--1357	23--25	161--163	5	**195**	697--1852	23--25	167--170	24
Trachonurus	*gagates*	C	**1**	1121	25	162	1					
	sentipellis	D	**4**	970--1000	21	157--158	2	**13**	775--1383	20--25	166--170	8
	sp. indet.											
Ventrifossa	*atherodon*	B	**17**	280--785	19--21	158--160	6	**6**	780--825	20--24	166--170	3
	johnboborum	D	**13**	421--1063	19--24	158--161	7	**27**	670--1240	20--25	165--170	14
	macropogon	D						**11**	640--825	21--25	166--170	6
	nigrodorsalis	D	**13**	607--842	19	158	5	**37**	450--800	18--24	163--168	11
	paxtoni	C	**11**	421--774	19	158	2	**27**	450--1102	20--24	165--170	12
	vinolenta	A	**10**	774--785	19--21	158--160	2					
TOTAL SPECIMENS			**427**					**872**				
TOTAL SPECIES			30					51				

Source : MNHN, Paris

			AREA III Matthew, Hunter, Vanuatu					AREA IV Wallace, Futuna					TOT Areas I-IV
		Distr type	Tot No	Depth (m)	Lat Deg S	Long Deg E	F	Tot No	Depth (m)	Lat Deg S	Long Deg W	F	
No. hauls/area							*148*					*116*	
SPECIES													
Bathygadidae													
Bathygadus	*cottoides*	C											12
	spongiceps	D											53
Gadomus	*introniger*	B	3	980--1191	15--22	167--171	3						5
	sp. indet.												1
Macrouridae													
Caelorinchus	*acutirostris*	B	1	399	15	167	1						3
	anatirostris	B	5	541-1220	15--16	166--168	3						14
	argentatus	B	15	398--566	15--19	167--169	8						30
	celaenostomus	C											10
	cingulatus	B	4	460--571	16--19	168--169	3	2	550	11	178	1	12
	cylindricus	A											1
	kermadecus	C											90
	melanobranchus	A											5
	mycterismus	C											1
	parallelus	C	2	775	18	168	1						7
	platorhynchus	B											2
	semaphoreus	B											1
	sereti	A	17	532-830	15--18	166--168	6						30
	shcherbachevi	C											4
	spathulatus	C											31
	supernasutus	C											1
	trachycarus	C											1
Cetonurichthys	*subinflatus*	D											1
Cetonurus	*crassiceps*	D	1	1190	15	166	1						14
Coryphaenoides	*rudis*	D											3
	striaturus	C											8
	dossenus	C	1	1032	16	166	1						3
Haplomacrourus	*nudirostris*	D	2	980--1050	16--18	166--168	2	1	747	12	174	1	3
Hymenocephalus	*adelscotti*	C						1	600	11	179	1	1
	aterrimus	D	2	764--990	18	168	2	7	747--1017	11--12	174--178	4	32
	gracilis	D											10
	kuronumai	B											6
	longibarbis	C	7	541--691	14--17	167--168	5						49
	megalops	B	178	433--830	14--19	167--169	13	3	590--635	11--12	176--179	2	390
	nascens	B	148	624--830	15--18	167--168	9	76	590--807	11--12	174--179	10	355
	nesaeae	A	3	764--1000	18	168--169	3						3
Kumba	*punctulata*	B	3	541--577	16--19	168--169	3						4
	musorstom	A											1
Kuronezumia	*bubonis*	D	1	825	15	167	1						1
Lucigadus	*acrolophus*	A	4	360--450	15--19	167--169	2						26
	microlepis	B	17	430--544	17--19	168--169	6	5	425	13	176	1	108
Macrosmia	*phalacra*	D	1	1190	15	166	1						1
Malacocephalus	*laevis*	D	3	624--668	17--18	168	2	1	805	12	177	1	7
Mataeocephalus	*acipenserinus*	D	11	748--1220	15--18	166--168	4	8	776--900	11--12	177--178	5	22
	adustus	B	2	1072--1190	15--18	167--168	2						2
	sp.	B	20	748--1000	15--18	167--169	7						26
Nezumia	*aspidentata*	A											1
	cliveri	A											2
	coheni	C											6
	propinqua	D	22	310--950	15--20	167--169	13	1	747	12	174	1	46
	spinosa	D						3	787--900	11--12	177--178	3	6
Pseudonezumia	*parvipes*	B											1
	pusilla	D	1	1190	15	166	1						2
Sphagemacrurus	*pumiliceps*	D	13	764--1086	15--18	167--169	7	8	787-1017	11--12	177--178	3	51
Squalogadus	*modificatus*	D											208
Trachonurus	*gagates*	C											1
	sentipellis	D	5	764--1050	16--22	166--171	5	5	787--807	12	177	2	27
	sp. indet.		1	1190	15	166	1						1
Ventrifossa	*atherodon*	B	18	624--950	17--18	168	6	7	597--793	11--12	177--179	6	48
	johnboborum	D	2	764-786	17--18	168	2	1	787	12	177	1	43
	macropogon	D											11
	nigrodorsalis	D	34	519--830	15--19	166-169	11	29	590--807	11--12	176--179	10	113
	paxtoni	C	50	469--936	15--19	166-169	15						88
	vinolenta	A											10
TOTAL SPECIMENS			597					158					2055
TOTAL SPECIES			33					16					63

Source : MNHN, Paris

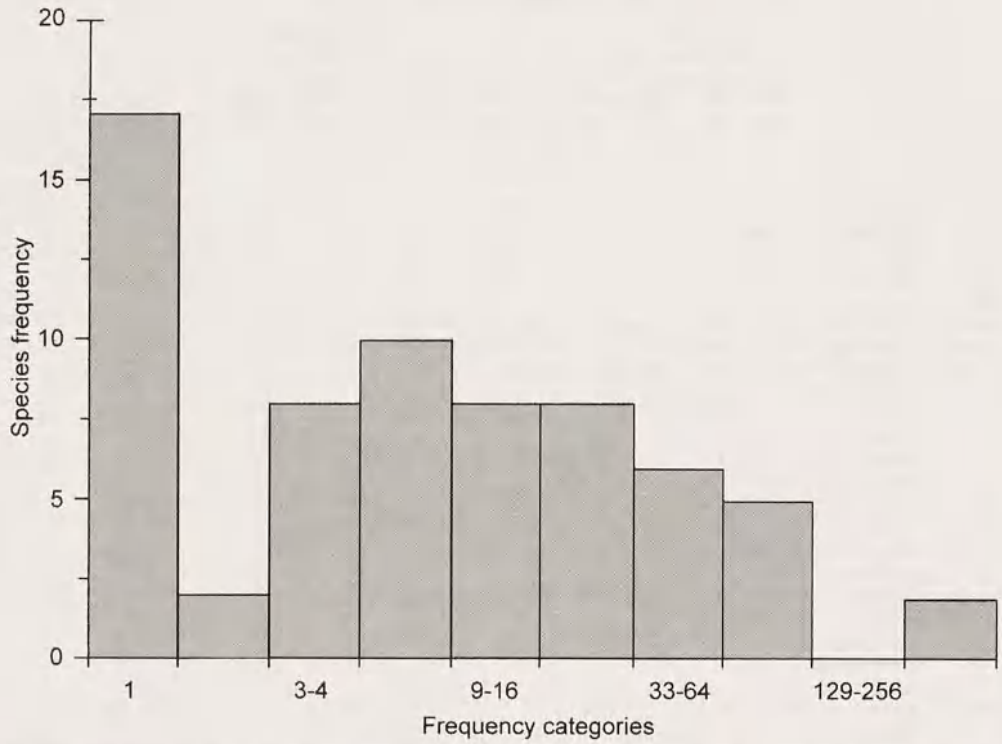

FIG. 2. — Species representation by specimen frequency category (specimens per species in the overall collection).

Sampling.

Grenadiers were recovered from only 22.8% of the samples (221 from 970) taken from all gears (Table 1). Largely this discrepancy could be accounted for by the high frequency of DW tows, which rarely caught grenadiers in the overall survey. Most of the grenadiers occurred in the ORBT (62.5%), CC (61.3%) and CP (43.6%) hauls. By area, only the smaller gears (CC, CP and DW) were used throughout; the large ORBT was not used in areas III and IV (Table 1).

A bathymetric plot of the 221 samples containing grenadiers indicates the dramatic effect that the sampling 'window' (in this case, gear type and size) has on the ecological implications of the samples (Fig. 3). The smaller nets collected grenadiers over a range of tows shallower than that suggested by the commercial gear (ORBT). The smaller nets sampled grenadiers from the 200-300 m stratum, with good representation down to 700 m. The ORBT used on the HALIPRO 2 cruise first collected these fishes in the 500-600 m stratum. Although relatively few ORBT tows were made at depths shallower than 600 m, sufficient were made to suggest that the lack of grenadier representation was an artefact. In the 600-700 m stratum 10 hauls lacked grenadiers, while two contained them (Fig. 4), but in the 1000-1100 m stratum the situation was reversed, with 14 samples in which grenadiers were represented and two in which they were not.

The size range of individual grenadiers sampled by the variety of gears was strikingly different (generally small specimens captured from the small nets vs large from the ORBT). This fact, together with the frequent ontogenetic smaller-shallower trend in these fishes (cf. discussion of such sampling limitations in MERRETT *et al.*, 1991) suggests a ready explanation for this sampling discrepancy. Extrusion through the large mesh size of the 30 m ORBT trawl probably accounted for a substantial loss of small specimens and the large bobbins used on the groundline possibly caused escapement beneath the net. This trend was confirmed qualitatively on the HALIPRO 2 cruise by the inclusion of a small ring net (*ca* 0.5 m diameter) inside the wings of the ORBT, which collected a variety of much smaller fishes than were retained on the meshes of the ORBT. In contrast, while the smaller gears would have sampled the smaller specimens well, large grenadiers could well avoid the on-coming mouth of a

Source : MNHN, Paris

small net towed at low speed. Taken separately, these two sets of data provide totally different views of the grenadier fauna of the region. Together, they confirm yet again the limitations influencing the validity of inferences drawn from deep-sea sampling (cf. ANGEL, 1977).

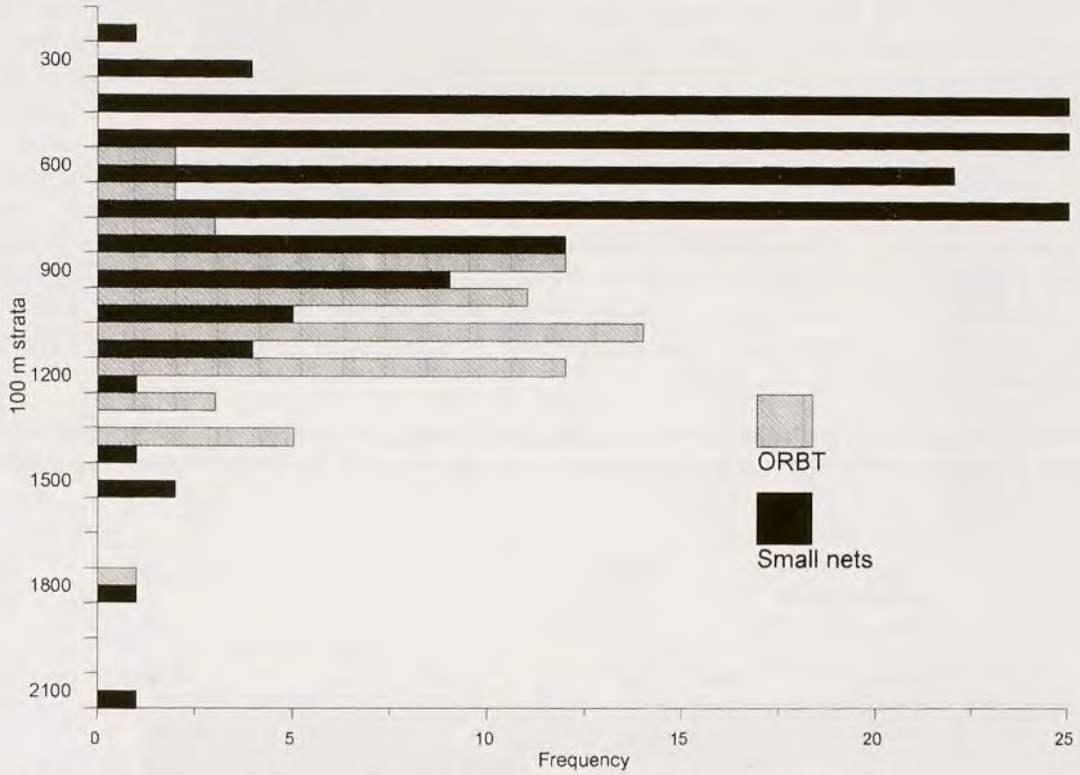

FIG. 3. — Distribution of samples containing grenadiers by 100 m depth strata, showing the difference between the small net catches and the commercial ORBT used on the HALIPRO 2 cruises (n = 221).

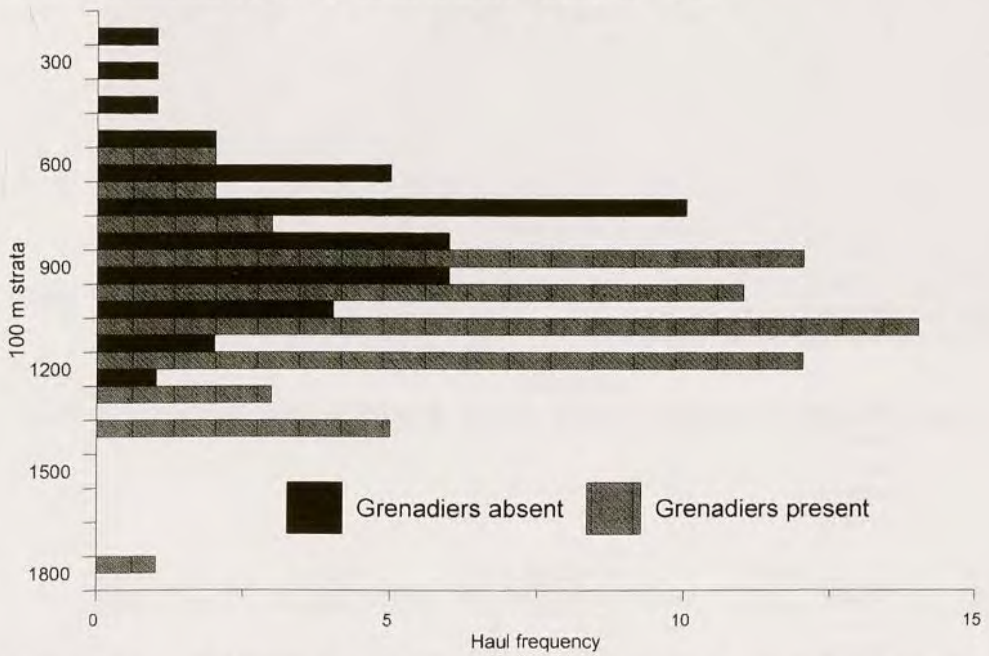

FIG. 4. — Trawl haul frequency by 100 m strata during the HALIPRO 2 cruises, divided into those hauls containing grenadiers and those without (n = 104).

Source : MNHN, Paris

Distribution - inter-area.

Species' depth distributions are given in Table 2, together with their geographic locations reflected by the catches. These relate to the regional groupings. Thus the two series of collections on the Indo-Australian Plate (areas I and II) were represented by 30 and 51 species respectively, whilst areas III and IV, on the Pacific Plate, yielded 33 and 16 species respectively (Table 3a). Table 3a also shows the percentage contribution to the overall grenadier species richness of the region, together with an inter-area comparison and the number of species unique to each. The situation it reveals is interesting, although confused. Areas I and III lacked many species found in area II, where 25% were unique in the catches there. Whether or not this reflects sampling disparity alone is debatable. Area IV yielded mostly widespread species and several species also found in Hawaii (e.g. *Caelorinchus cingulatus*, *Hymenocephalus aterrimus*, *Mataeocephalus acipenserinus*, *Nezumia propinqua*, *Sphagemacrurus pumiliceps*, *Trachonurus sentipellis*, and *Ventrifossa atherodon*). Whilst area II had high numbers of co-occurring species with area I (26) and areas III (27), co-occurrence was much reduced between areas I and III (16). Co-occurrence between these areas individually and area IV was rather similar (area I - 10, II - 14, III - 14) and high in relation to overall species representation in IV.

TABLE 3. — (**a**), The number of grenadier species co-occurring among the areas sampled, together with the total numbers of species and their proportions of the whole per area and the number of species unique to each; (**b**), subdivided by genus.

(a) **OVERALL**

Grenadier hauls/ total by area	27/128	131/578	44/148	19/116			
					TOTAL SPECIES		
Region	**Area I**	**Area II**	**Area III**	**Area IV**	**No.**	**%**	**Unique**
Area I	-	26	16	10	30	49	5
Area II	26	-	27	14	51	81	13
Area III	16	27	-	14	33	52	5
Area IV	10	14	14	-	16	25	1
TOTAL					**63**		**24**

(b) ***CAELORINCHUS***

Region	**Area I**	**Area II**	**Area III**	**Area IV**	**Unique**	*Total*
Area I	-	6	3	0	0	*6*
Area II	6	-	6	1	8	*17*
Area III	3	6	-	1	0	*6*
Area IV	0	1	1	-	0	*1*

HYMENOCEPHALUS

Region	**Area I**	**Area II**	**Area III**	**Area IV**	**Unique**	*Total*
Area I	-	3	2	2	1	*4*
Area II	3	-	4	3	0	*5*
Area III	2	4	-	**4**	1	*5*
Area IV	2	3	**4**	-	1	*4*

NEZUMIA

Region	**Area I**	**Area II**	**Area III**	**Area IV**	**Unique**	*Total*
Area I	-	2	1	1	1	*3*
Area II	2	-	1	2	1	*4*
Area III	1	1	-	1	0	*1*
Area IV	1	2	1	-	0	*2*

VENTRIFOSSA

Region	**Area I**	**Area II**	**Area III**	**Area IV**	**Unique**	*Total*
Area I	-	4	4	3	1	*5*
Area II	4	-	4	3	1	*5*
Area III	4	4	-	3	0	*4*
Area IV	3	3	3	-	0	*3*

Source : MNHN, Paris

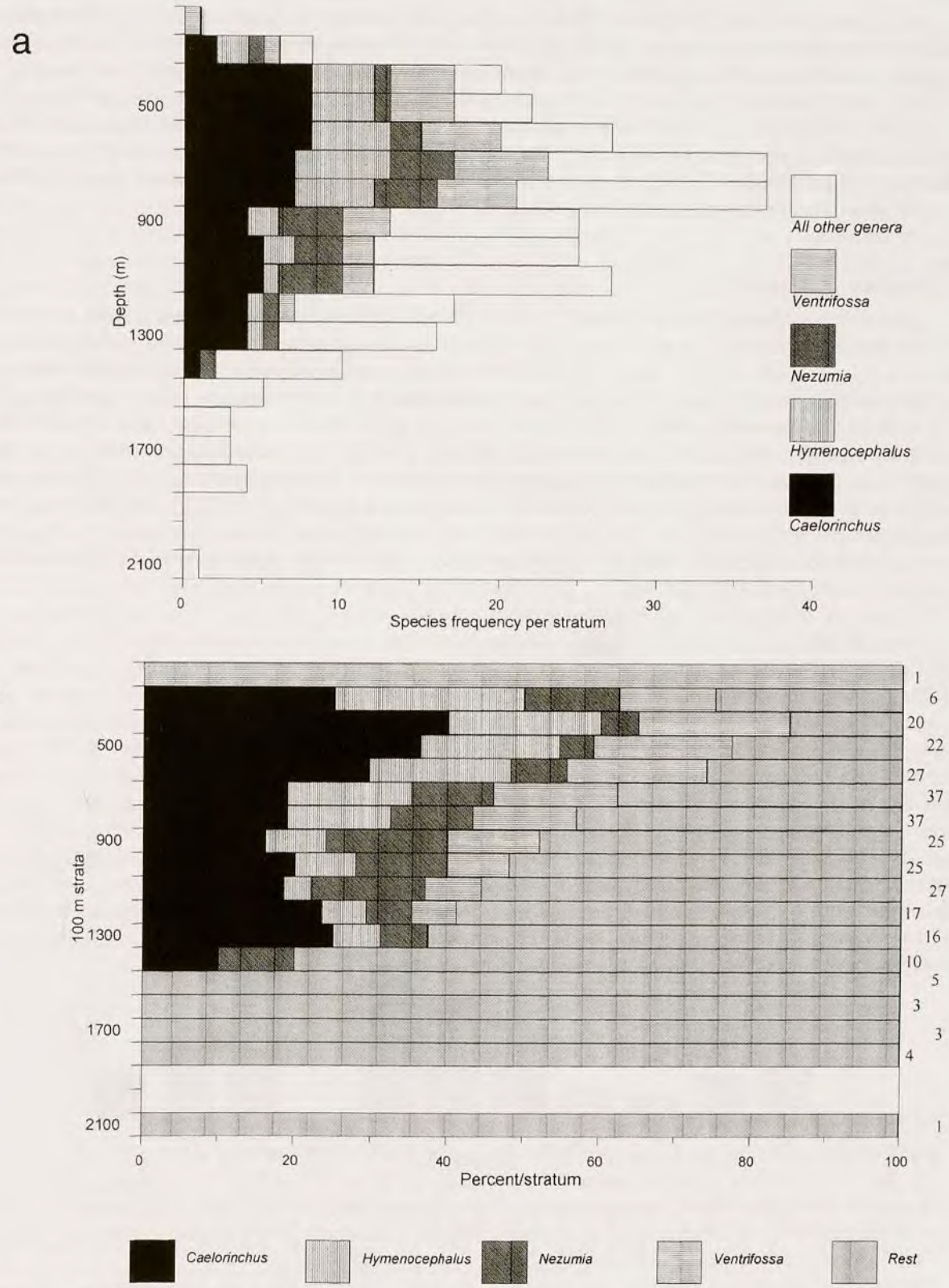

FIG. 5. — (**a**), Overall species bathymetric distribution by 100 m strata (assuming congruity of occurence across strata), with the dominant genera indicated; (**b**), As a percentage distribution, with the number of collections per stratum indicated down the right axis.

Source : MNHN, Paris

Looking at the more speciose genera (Table 3b - *Caelorinchus*, *Hymenocephalus*, *Nezumia* and *Ventrifossa*), widespread species were not common. Indeed, 8 species of *Caelorinchus* occurred solely in area II, where a total of 17 species were encountered and far more than in any other area. The *Hymenocephalus* were peculiar as a group; *adelscotti* and *kuronumai*, for example, were each confined to a single area and, while *adelscotti* was hitherto undescribed (IWAMOTO & MERRETT, 1997), the record of *kuronumai* extended its known range from the Japan region. *Hymenocephalus gracilis* and *H. longibarbis* could both have been expected to occur in areas I-III, but instead co-occurred only in I-II and II-III, respectively (Table 2). The geographic distribution of species of *Nezumia* and *Ventrifossa* were more regular in their occurrence.

Distribution - bathymetric.

Co-occurrence of grenadier species within similar depth strata on the slope was remarkably high, with only two of the 63 species not represented, at least over part of their depth range, in the upper 1600 m. Assuming congruity in occurrence across the strata in which the shallowest and deepest representatives of each genus were caught, Fig. 5a shows the potential species richness within the strata sampled. Thus, grenadier species richness peaked at 37 in both the 700 and 800 m strata, although it did not drop below 20 across the depth range 400-1100 m and reduced substantially only deeper than 1400 m (and shallower than 400 m). In depths down to 900 m most of this diversity was contributed by co-occurring species of *Caelorinchus*, *Hymenocephalus (sensu lato)*, *Ventrifossa* and *Nezumia* (Fig. 5b). Excluding the single collection in the 200 m stratum from consideration, more than 70% of the grenadiers occurring across the 300-600 m band were representatives of these four genera, although their combined influence on grenadier stratum diversity decreased steadily to their disappearance in the 1500 m stratum. In the two richest strata (700 and 800 m), seven species of *Caelorinchus* in each level co-occurred with five (700 m) and six (800 m) each of *Hymenocephalus* and *Ventrifossa*, and four of *Nezumia* (Fig. 5a). This exceptional degree of co-occurrence may be compared with that commented upon by MERRETT & MARSHALL (1981, p. 228) off northwest Africa. In that region 18 out of 26 grenadier species sampled from the depth range 261-6059 m were found to occur in soundings shallower than 1600 m, with high incidence of sympatry only in the genus *Nezumia* (4 species over the range 600-1200 m). Nevertheless, the maintenance of such an association of closely related species prompted MERRETT & MARSHALL (1981) to consider niche availability. While their data were similarly preliminary in nature to ours, they observed indications of niche separation in the centres of abundance in depth distribution and trophic relations. The present data from the New Caledonian region indicate far greater potential competitive overlap among species of the four genera mentioned above and over a narrower depth range (Fig. 5). Such dietary evidence as was gathered from this collection, however, provides little insight into trophic separation among this assemblage. Further sampling is necessary to establish whether differences in bathymetric centres of abundance might alleviate interspecific competition. Meanwhile, the situation found around New Caledonia, as off northwest Africa, further supports the view of GRASSLE & SANDERS (1973) that in general a low degree of competitive exclusion exists among deep-sea species.

ZOOGEOGRAPHY

Regional distributions of grenadiers.

Many grenadier species are known for their widespread distributions and such an element can be identified among the slope-dwelling grenadier fauna of New Caledonia. Other rather ill-defined components can also be recognised to distinguish four groupings among the overall assemblage. Thus there is an endemic component (species designated 'A' in Table 2), a broad, northern, tropical component ('B'), a southern, temperate component ('C'), and a widespread, global or multiple-ocean-basin component ('D').

The endemic category is small and may not hold up with extensive sampling in other areas. For now, the species that can be included in this category include *Caelorinchus cylindricus*, *C. melanobranchus*, *C. sereti*, *Hymenocephalus nesaeae*, *Kumba musorstom*, *Lucigadus acrolophus*, *Nezumia aspidentata*, *N. cliveri*, and *Ventrifossa vinolenta*.

Source : MNHN, Paris

Category B comprises the following species found in tropical waters to the west and north, especially tropical Australia, Indonesia, Philippines, and the East China Sea to southernmost Japan: *Caelorinchus acutirostris*, *C. anatirostris*, *C. argentatus*, *C. cingulatus*, *C. platorhynchus*, *C. semaphoreus*, *Gadomus introniger*, *Hymenocephalus kuronumai*, *H. megalops*, *H. nascens*, *Kumba punctulata*, *Lucigadus microlepis*, *Mataeocephalus adustus*, *Mataeocephalus* sp., *Pseudonezumia parvipes*, and *Ventrifossa atherodon*.

Category C includes species found in temperate waters to the south and west, particularly in waters off New Zealand and southern Australia, although three species have ranges extending to southern Africa: *Bathygadus cottoides*, *Caelorinchus celaenostomus*, *C. kermadecus*, *C. mycterismus*, *C. spathulatus*, *C. supernasutus*, *C. trachycarus*, *Coryphaenoides dossenus*, *C. striaturus*, *Hymenocephalus adelscotti*, *H. longibarbis*, *Nezumia coheni*, *Trachonurus gagates*, and *Ventrifossa paxtoni*. The ties to the New Zealand fauna (see below) are seen in the presence of the six species of *Caelorinchus*, all of which were taken south of New Caledonia on one or more of three oceanic ridges that form a connection with New Zealand (*C. mycterismus* and *C. trachycarus* are also known from southeastern Australia). *Bathygadus cottoides*, *Coryphaenoides dossenus* and *C. striaturus* are found across the Indian Ocean to subtropical to temperate waters off southern Africa.

The last category (D) includes numerous widespread species that are broadly distributed across one or more oceans. Some of these, when they are closely studied, may be shown to consist of two or more species, each of which has a narrower distribution. These species are: *Bathygadus spongiceps*, *Cetonurichthys subinflatus*, *Cetonurus crassiceps*, *Coryphaenoides rudis*, *Haplomacrourus nudirostris*, *Hymenocephalus aterrimus*, *H. gracilis*, *Kuronezumia bubonis*, *Macrosmia phalacra*, *Malacocephalus laevis*, *Mataeocephalus acipenserinus*, *Nezumia spinosa*, *N. propinqua*, *Pseudonezumia pusilla*, *Sphagemacrurus pumiliceps*, *Squalogadus modificatus*, *Trachonurus sentipellis*, *Ventrifossa johnboborum*, *V. macropogon*, *V. nigrodorsalis*.

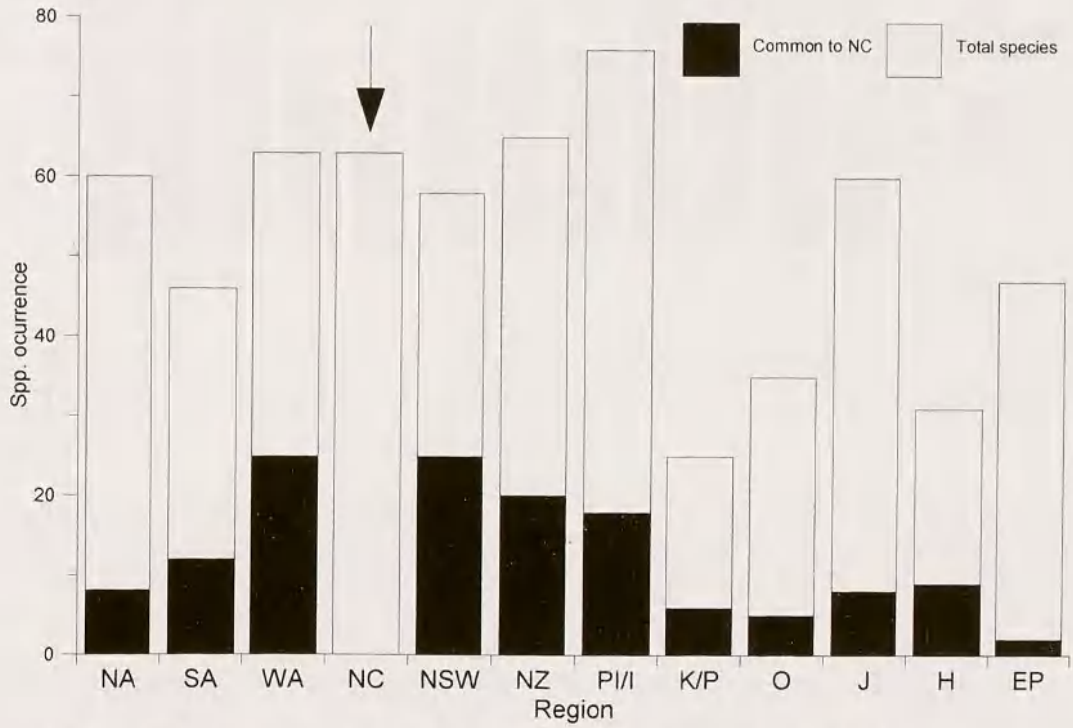

FIG. 6. — Global regional comparison of grenadier species frequency of occurrence, indicating the frequency of species common to the New Caledonian region (arrowed). (**NA**, North Atlantic; **SA**, South Africa; **WA**, Western Australia; **NC**, New Caledonia; **NSW**, New South Wales; **NZ**, New Zealand; **PI/I**, Philippine Is/Indonesia; **K/P**, Kyushu/Palau Ridge; **O**, Okinawa Trough; **J**, Japan; **H**, Hawaii; **EP**, Eastern Pacific.)

Figure 6 shows the representation of known species of grenadier by region and those in common occurrence with New Caledonia. There are 58 species found in New South Wales (NSW), of which 25 co-occur with

Source : MNHN, Paris

New Caledonia (Table 4). (This total in common could be greatly increased with the inclusion of Queensland, but the data are far from adequate from this poorly sampled region of Australia.) New Zealand, another of the few well-sampled areas within the New Caledonian region, has 65 species, with only 20 in common. Almost all those species in common (within our category C, see above) are those with southerly distributions and mostly to the south of New Caledonia (e.g. *Bathygadus cottoides*, *Caelorinchus celaenostomus*, *C. kermadecus*, *C. mycterismus*, *C. spathulatus*, *C. supernasutus*, *C. trachycarus*, *Coryphaenoides striaturus*, *C. dossenus*, *Trachonurus gagates*). It is noteworthy that in the entire eastern Pacific region, however, there are only two species found in common with New Caledonia. The eastern Pacific grenadier fauna is very distinct as will be seen below. There is a high frequency of grenadier representation in many regions, often totalling around 60 (overall histograms in Fig. 6), of which the number co-occurring with New Caledonia (solid histograms - Fig. 6) is variable. As would be expected, those closest to New Caledonia have the highest number of species in common, although even more remote regions (e.g. North Atlantic) share the most widespread species (Fig. 6). While the Hawaiian assemblage shares only one more species in common than does that in the North Atlantic, a greater proportion are common than occur in the Kyushu/Palau Ridge, Okinawa Trough or Japan areas (Table 4). New South Wales and Western Australia share the most species in common with New Caledonia (25), although in percentage terms the shared species in Western Australia are more (67% cf. 57%).

TABLE 4. — Global regional comparison of grenadier genera and species known distributions, with reference to comparisons with the New Caledonian region and the dominant genera found there. (**NA**, North Atlantic; **SA**, South Africa; **WA**, Western Australia; **NC**, New Caledonia; **NSW**, New South Wales; **NZ**, New Zealand; **PI/I**, Philippine Is/Indonesia; **K/P**, Kyushu/Palau Ridge; **O**, Okinawa Trough; **J**, Japan; **H**, Hawaii; **EP**, Eastern Pacific.)

	Genera:	**Species:**						
Area	Total	Total	common to NC	*Caelorinchus*	*Coryphaenoides*	*Hymenocephalus*	*Nezumia*	*Ventrifossa*
NA	20	60	8	5	15	4	9	5
SA	20	46	12	9	6	1	7	4
WA	20	63	25	20	4	5	7	6
NC	20	63	-	17	3	8	5	6
NSW	21	58	25	15	8	3	4	3
NZ	21	65	20	21	12	4	4	0
PI/I	17	76	18	23	10	9	4	4
K/P	9	25	6	7	2	3	3	6
O	9	35	5	16	2	5	2	5
J	14	60	8	18	13	7	5	4
H	16	31	9	7	2	4	6	2
EP	12	47	2	6	21	1	10	0

At the generic level, regional comparisons show some interesting trends (Table 4). The total number of grenadier genera in the Atlantic and the Indo-southwest Pacific, as indicated from sampling in six broad regions, is rather similar at 20-21 genera. The remainder of the Pacific area, however, have reduced and less consistent numbers of genera represented. At the specific level, *Caelorinchus* is the most species-rich genus of grenadier with well over 100 species, of which many are still undescribed. It is well represented in most regions, although low species frequency in the Atlantic and eastern Pacific suggest that this is predominantly an Indo-West Pacific group (Table 4). At least 17 species of *Caelorinchus* occur around New Caledonia to comprise 28% of the grenadier assemblage there. Similar high frequencies are apparent in the Australian, New Zealand, Philippines/Indonesian and Japanese regions. Yet there is a similarly low species representation in the eastern Pacific and Hawaii as occurs in the Atlantic. Surprisingly, only three species of *Coryphaenoides* were represented in the New Caledonian region, but that number could increase with more sampling on the continental rise below 2000 m. While the representation by region is varied worldwide, *Coryphaenoides* contrasts with *Caelorinchus* by being proportionally better represented in the North Atlantic and the eastern Pacific (Table 4). On the other hand, the eight species of *Hymenocephalus* in New Caledonia is the highest number recorded from any region other than the Philippines and

Source : MNHN, Paris

Indonesia (9 spp.) (Table 4). While five species of *Nezumia* were collected in the New Caledonian region, and this is not a high representation, three of these were new (Table 4). In percentage terms, this genus contributes more to the overall assemblage in the North Atlantic, South Africa and central (Hawaii) and eastern Pacific (Fig. 7). The taxonomy of *Ventrifossa* is complicated by the variability of the suite of diagnostic characters used. Nevertheless, six species are recognized from New Caledonia, two of which were recently described as new, and this comprises a larger group than in any other region surveyed (except Western Australia also with six).

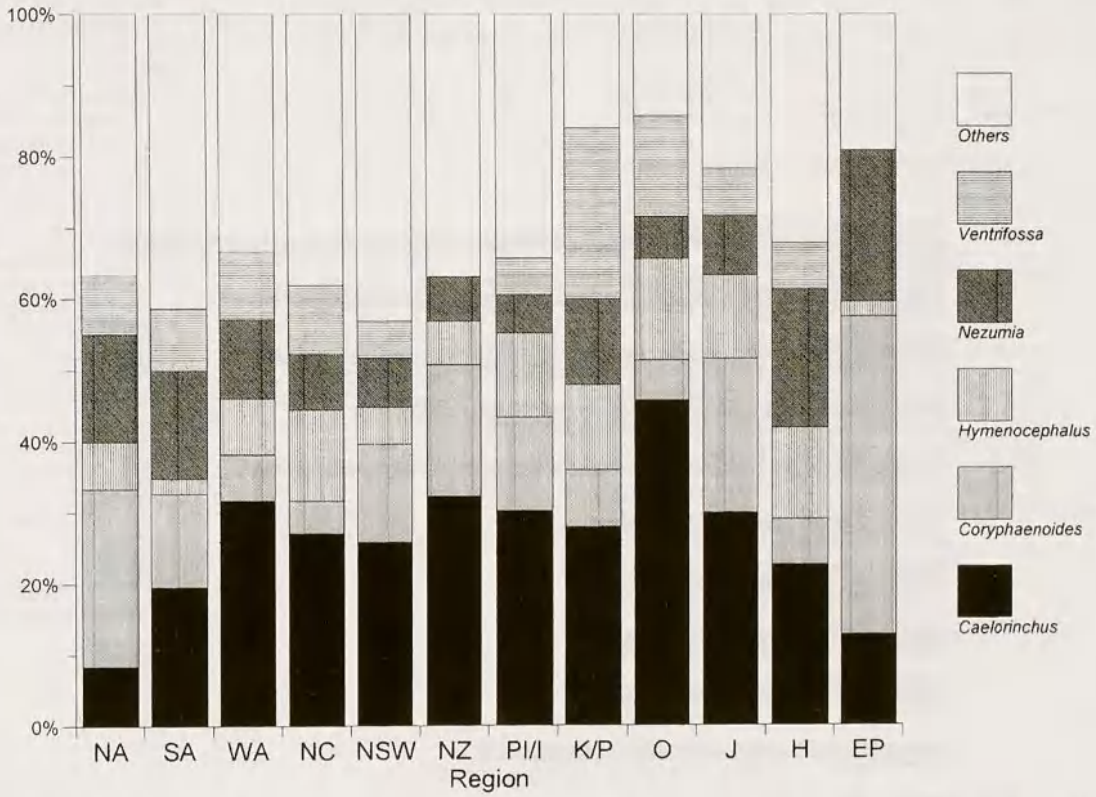

FIG. 7. — Global regional percentage comparison of grenadier species by main genera occurring in New Caledonia. (**NA**, North Atlantic; **SA**, South Africa; **WA**, Western Australia; **NC**, New Caledonia; **NSW**, New South Wales; **NZ**, New Zealand; **PI/I**, Philippine Is/Indonesia; **K/P**, Kyushu/Palau Ridge; **O**, Okinawa Trough; **J**, Japan; **H**, Hawaii; **EP**, Eastern Pacific.)

While regions northward and eastward of New Zealand have reduced generic representation relative to the remainder (Table 4), it is there where the proportion of the grenadier assemblage contributed by the five genera *Caelorinchus*, *Coryphaenoides*, *Hymenocephalus*, *Nezumia* and *Ventrifossa* together is greatest (Fig. 7). These five dominant genera together comprise 62% of the total grenadier fauna of the New Caledonian region. The eastern Pacific is noteworthy for its high representation of *Nezumia* and *Coryphaenoides*, more than in any other area, yet *Ventrifossa* is absent. The 21 species of *Coryphaenoides* in the eastern Pacific is 45% of the total grenadier fauna there (Fig. 7). In no other region of commensurate size is there such a dominance of one genus. Yet the Okinawa Trough, a much smaller area, holds in the genus *Caelorinchus* a similar 45% of the total of 35 grenadier species. The species total of this group of five genera rises through 66% in the Philippine and Indonesian regions, however, to 78-86% peripherally around the North Pacific, in the Kyushu/Palau Ridge region, the Okinawa Trough, Japan and the eastern Pacific. Centrally, in Hawaii, the proportion (68%) is more akin to the range in further westerly and southerly regions. When making such inter-area comparisons, however, it must be stressed that sampling strategies have not been consistent worldwide. Since grenadier species, like other deep demersal groups, are constrained between various species-specific bathymetric limits, overall sampling coverage is

Source : MNHN, Paris

important. While the majority of grenadier species are encountered over slope depths to around 2500 m, complete coverage is not obtained to at least 4000 m (cf. MERRETT, 1992). Thus in this comparison, the apparent low proportion around New Caledonia of species of the genus *Coryphaenoides*, generally the deepest living of the five dominant genera treated, may result more from poor sampling coverage below about 1500 m than from absolute scarcity. This can be confirmed only by further sampling.

Few data are available from these collections to examine inter-area bathymetric distributions at the generic level. The most speciose genus, *Caelorinchus*, offers some evidence (Fig. 8), but such variation that does occur may be due to sampling limitations (e.g., the lack of using the ORBT in areas III and IV where species of large adult size like *C. kermadecus*, *C. supernasutus* and *C. trachycarus* may have been present deep but not sampled).

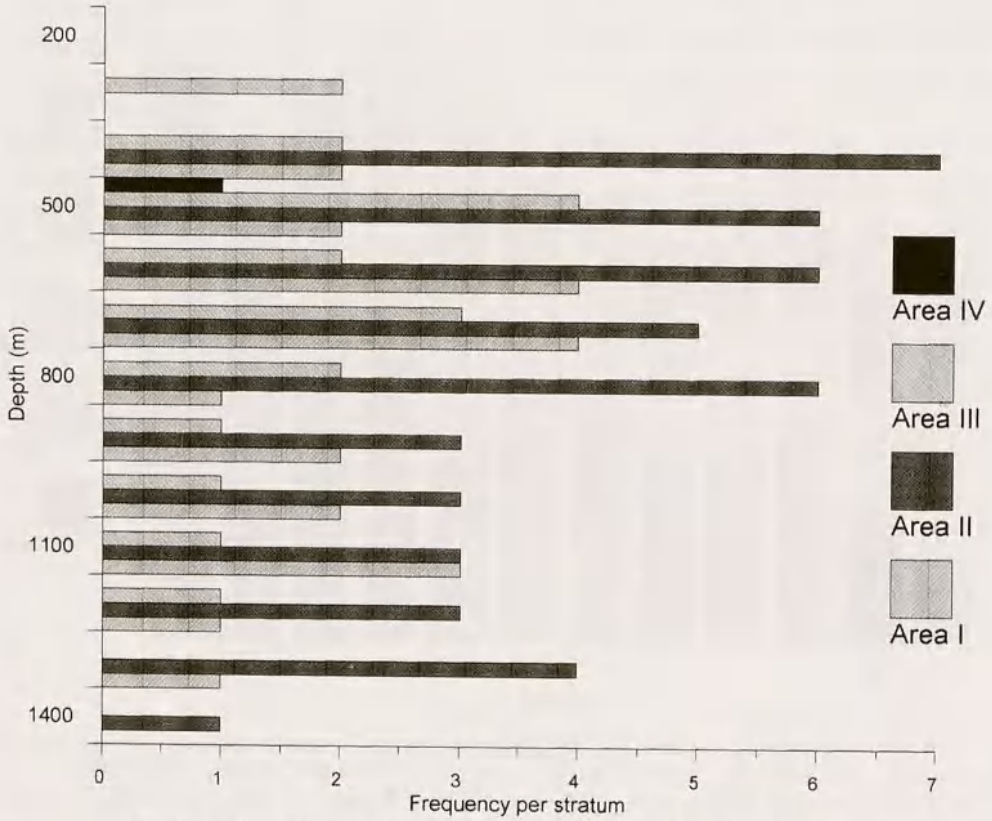

FIG. 8. — Vertical distribution of the species of *Caelorinchus* by area.

POPULATION BIOLOGY

A summary of population biology parameters obtained from the samples is given in Table 5. While not extensive, it provides preliminary data on the reproductive biology and diet of the more abundant species. In addition, Figs 10, 11,19, 20, 24, 28 and 29 give the length-frequency distributions of some of the more abundant species, individually commented upon in the species accounts below.

Less can be said about the more infrequently represented species. Results of the examinations are given in Table 5. Certain preliminary remarks, however, can be made concerning resource partitioning in the co-occurring genera *Caelorinchus*, *Hymenocephalus* (*sensu lato*), *Ventrifossa* and *Nezumia*. While adult size, based upon attainment of ovarian maturity, may partition species into preferred prey-size categories, there is little evidence here to suggest that intrageneric trophic segregation occurs. Most species seem to feed benthopelagically on a mixed diet. More detailed work using larger samples is needed for any greater clarification.

Source : MNHN, Paris

TABLE 5. — Summary of reproductive and feeding data from the dominant species from the New Caledonian region. (* - macrosmatic males; **$** - several generations of ripening ova present; **S/NS** - sediment present/absent; **G. no.** - gonad examination sample size; **S. no.** - stomach contents examination sample size; **E** - number of stomachs found empty.)

SPECIES	G. no.	M:F sex ratio	Size at 1st mat.	Stomach contents material S.no.	E		S/NS
Bathygadus cottoides	3	1:2	>66.5	-	-	-	-
Caelorinchus anatirostris	5	1:2	-	5	4	Copepod	NS
Caelorinchus argentatus	15	1:1.5	-	3	1	Ostracod, polychaete	NS
Caelorinchus cingulatus	5	2:1	-	3	1	Copepod, isopod & polychaete	S
Caelorinchus melanobranchus	2	2:0	-	2	-	Crustacean (galathaeid), squid.	NS
Caelorinchus spathulatus	28	1.5:1	55-60	5	1	Copepod, polychaete, fish (Bregmaceros sp.)	S
Caelorinchus sereti	6	1:1.5	>100	1	-	Decapod crustacean, ?myctophid otoliths	NS
Coryphaenoides striaturus	1	1:0	>78.0	-	-	-	-
Haplomacrourus nudirostris	1	1:0	-	1	-	polychaete, ?squid beak, fish lens,?bryozoan mat	S
Hymenocephalus adelscotti	1	0:1$	<31	-	-	-	-
Hymenocephalus aterrimus	8	6*:1$	<31	-	-	-	-
Hymenocephalus kuronumai	5	1:1.5$	<43	4	2	Decapod crustacean	NS
Hymenocephalus longibarbis	3	2*:1	ca 20	1	-	Fish	-
Hymenocephalus megalops	12	1*:1.4$	13-22	1	-	Crustacean	NS
Hymenocephalus nascens	29	1*:1.2$	12-17	6	2	Crustacean (euphausiid)	NS
Lucigadus acrolophus	8	1*:1.3$	<22	-	-	-	-
Lucigadus microlepis	19	1.1*:1$	18-20	3	-	Crab zoea, euphausiid/decapod, isopod & copepod	S
Malacocephalus laevis	2	0:2	<57	-	-	-	-
Mataeocephalus acipenserinus	10	1:1.25	36-46	2	1	Crustacean (copepod)	NS
Mataeocephalus brevirostris	4	1:3	40-51	3	3	-	NS
Nezumia propinqua	7	1*:1.3$	20-24	6	-	Polychaete, copepod, amphipod, isopod, ophiuroid.	S
Nezumia spinosa	3	2*:1$	,31.5	1	1	Crustacean	NS
Sphagemacrurus pumiliceps	26	1*:1.18$	24-33	12	8	Crustacean (copepod)	NS
Trachonurus sentipellis	10	2.5*:1$	41-69	3	1	Polychaete, lamellibranch, pteropod, crustacean, echinoderm.	NS
Ventrifossa atherodon	18	2.2*:1	<56	6	-	Decapod crustacean, amphipod, fish.	NS
Ventrifossa johnboborum	8	1*:3$	59-88.5	4	3	Decapod crustacean, squid.	NS
Ventrifossa nigrodorsalis	32	1.4*:1$	38-40	8	-	Crustacean ('spider crab'), polychaete.	NS
Ventrifossa vinolenta	6	1*:1$	33-44	1	1	-	NS

SYSTEMATIC ACCOUNT

Family BATHYGADIDAE

Genus ***BATHYGADUS*** Günther, 1878

Bathygadus cottoides Günther, 1878

Fig. 9 a

Bathygadus cottoides - IWAMOTO & MERRETT, 1997: 479-480 (in part; most spec. *B. spongiceps*; see below).

MATERIAL EXAMINED. — 17 specimens.

Norfolk Ridge. HALIPRO 2: stn BT 43, 25°41.75'S, 167°11.59'E, 1030-1320 m, 15.11.1996: 3 specimens (CAS 90556).

Lord Howe Rise. HALIPRO 2: stn BT 102, 24°32.97'S, 161°53.65'E, 1060-1130 m, 26.11.1996: 1 specimen 33 mm HL, 133+ mm TL (CAS 90749). — Stn BT 104, 25°23.01'S, 162°35.40'E, 1118-1124 m, 27.11.1996: 1 specimen 38.2 mm HL, 178+ mm TL (CAS 90835). — Stn BT 105, 25°42.93'S, 162°47.98'E, 1200-1218 m, 27.11.1996: 1 specimen 27.2 mm HL (CAS 90845).

Kermadecs. West of Kermadec Trench, 30°32.00'S, 178°22.00'W, 971 m depth over 1100 m soundings, 5.12.1976: 5 of 11 specimens 29-38.5 mm HL, 150+ -177+ mm TL (NMNZ P10850). — Esperance Rock: 2 specimens 28-33 mm HL, 142+ -150+ mm TL (NMNZ P20066).

New Zealand. East coast of North Island, 40°85'S, 177°02'E, 1353-1339 m, 03.1967: 1 specimen 30.5 mm HL, 186 mm TL (NMNZ P34691, ex NZOI E750). — Challenger Plateau, 39°59.70'S, 167°38.20'E, 1175-1181 m,

Source : MNHN, Paris

19.03.1984: 2 of 17 specimens 35-39 mm HL, 145+ -214 mm TL (NMNZ P23477). — RV *Tangaroa* 9406/229, Chatham Rise, 42°39.65'S, 172°17.66'W, 1505-1524 m, 24.06.1994: 1 specimen 39 mm HL, 260+ mm TL (NMNZ P34751).

REMARKS. — IWAMOTO & MERRETT (1997) misidentified most of their specimens of *B.* sp. *cf. spongiceps* with *B. cottoides* in their treatment of the grenadiers of New Caledonia. The second author (TI) has subsequently examined numerous specimens of *B. cottoides* in the Museum of New Zealand taken from the Kermadecs (the type locality) and the New Zealand EEZ. These specimens were all small, with characters similar to those recorded by IWAMOTO & ANDERSON (1994) from southern Africa. *B. cottoides* is a small species (probably not more than about 30 cm TL) unlike *B.* sp. *cf. spongiceps*, which attains a considerable size (more than 45 cm TL). *B. cottoides* has fewer pectoral fin rays (i10-i14, rarely i15, *cf.* i15-i18 in *B.* sp. *cf. spongiceps*), fewer pyloric caeca (8-12 *cf.* 18-27), broader suborbital width (16-19% HL *cf.* 14-17%), and a darker body.

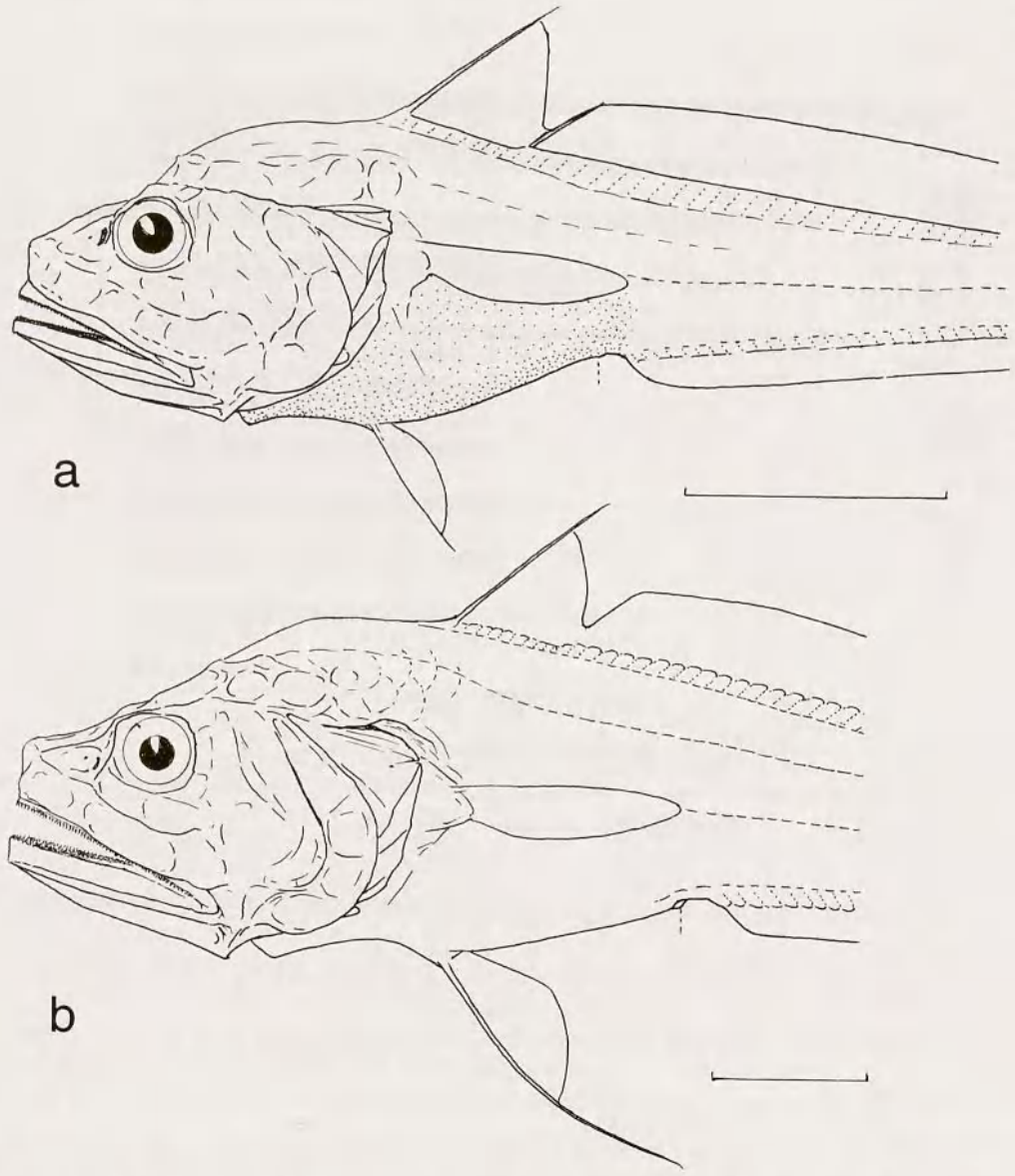

FIG. 9. — Diagrammatic illustrations of (**a**) *Bathygadus cottoides* Günther, 1878 (AMS I.29745-007) from off New South Wales, Australia; (**b**) *Bathygadus cf. spongiceps* (CAS 98532) from off Lord Howe Rise. Scale = 25 mm.

Source : MNHN, Paris

Bathygadus sp. *cf. spongiceps*

Figs 9 b, 10

Bathygadus cottoides - IWAMOTO & MERRETT, 1997: 479 (in part; 3 spec. from CAS 90556 and 1 spec. from CAS 90835 are *B. cottoides*, all others listed are *B. spongiceps*).

MATERIAL EXAMINED. — 14 specimens.

Norfolk Ridge. HALIPRO 2: stn BT 41, 25°47.77'S, 167°11.52'E, 1317-1383 m, 14.11.1996: 1 specimen 81 mm HL, 445+ mm TL (BMNH 1997.5.21:31). — Stn BT 43, 25°41.75'S, 167°11.59'E, 1030-1320 m, 15.11.1996: 3 specimens (CAS 90556). — Stn BT 55, 25°02.85'S, 168°45.42'E, 1098-1480 m, 17.11.1996: 1 specimen 85 mm HL, 450+ mm TL (BMNH 1997.5.21:44), 1 specimen (CAS 90667), 1 specimen 70 mm HL, 415 mm TL (MNHN 1998-245). — Stn BT 56, 25°02.92'S, 168°46.04'E, 1083-1196 m, 17.11.1996: 1 specimen (NMNZ P.34251), 1 specimen (NMNZ P.34269). — Stn BT 59, 24°58.35'S, 168°42.31'E, 1312-1520 m, 18.11.1996: 1 specimen 62 mm HL, 282+ mm TL (CAS 90748). — Stn BT 66, 24°43.92'S, 168°28.78'E, 885-1450 m, 19.11.1996: 1 specimen 73 mm HL, 420 mm TL (CAS 90685). — Stn BT 75, 24°13.17'S, 167°36.52'E, 1128-1150 m, 21.11.1996: 2 specimens (CAS 90992).

Loyalty Ridge. HALIPRO 2: stn BT 23, 25°04.95'S, 170°11.7'E 1105-1360 m, 10.11.1996: 1 specimen (CAS 90993), 1 specimen (MNHN 1998-251).

Lord Howe Rise. HALIPRO 2: stn BT 95, 23°56.86'S, 162°07.57'E, 1224-1233 m, 25.11.1996: 1 specimen 92 mm HL, 505+ mm TL (MNHN 1998-246).

See IWAMOTO & MERRETT, 1997: 479 (all specimens in Materials examined except CAS 90556 and CAS 90835).

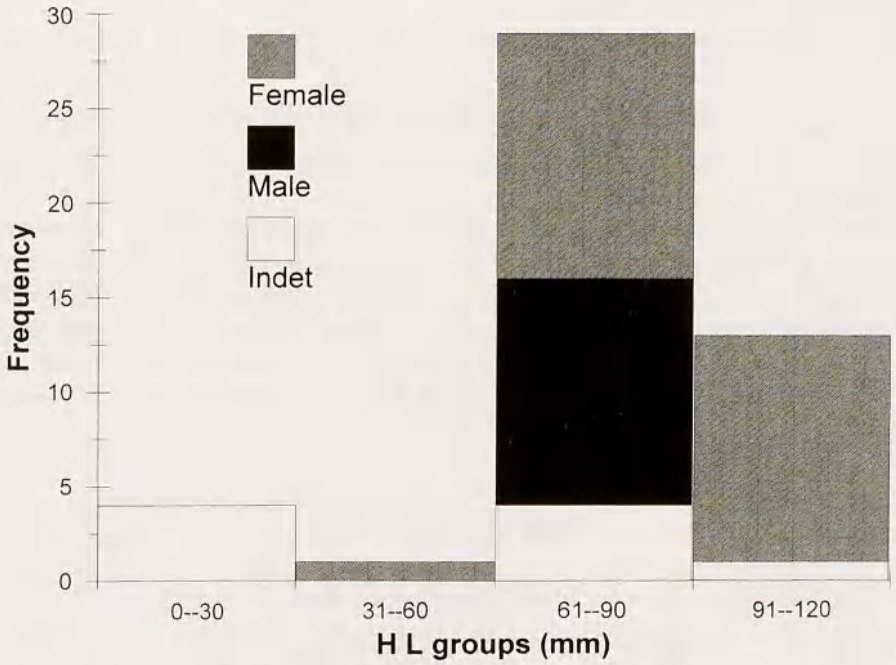

FIG. 10. — Length-frequency (HL, head length mm) distribution of *Bathygadus cf. spongiceps* by sex (n = 47).

REMARKS. — The correct identification of these specimens is uncertain although they are closely similar to *B. spongiceps*, which has been recorded from Philippine and Indonesian waters. The main character distinguishing this species and *B. spongiceps* is the dentition of the lower jaw, which in *B. spongiceps* is in a very narrow band, reduced anterolaterally on the jaw to an irregular double row. In the New Caledonian species the band in that region is about four irregular series wide. Also, *B. spongiceps* appears to be much softer bodied and has fewer pyloric caeca (15-21 *cf.* 18-27). A closer study of this species is necessary. *Bathygadus* sp. *cf. spongiceps* was frequently taken during the HALIPRO 2 cruise. On the Norfolk Ridge it was captured in 15 trawls, on the Lord Howe Rise six trawls, on the Loyalty Ridge one trawl. Capture depths ranged between 885 m and 1520 m. The species was never taken in numbers, however, the most being nine specimens, with one to five most frequent. The large trawl

Source : MNHN, Paris

deployed by the RV *Tangaroa* probably accounted for its frequent capture and larger size than in previous ORSTOM cruises. The largest adult size was attained by females in these samples (Fig. 10). The distribution of the species appears to extend through New Zealand and Australia. The northern extent is uncertain as there remains a question as to synonyms.

Genus ***GADOMUS*** Regan, 1903

Gadomus introniger Gilbert & Hubbs, 1920

Gadomus introniger - IWAMOTO & MERRETT, 1997: 480-481, Fig. 4 (Matthew & Hunter Islands).

MATERIAL EXAMINED. — 4 specimens.

Vanuatu. MUSORSTOM 8: stn CP 990, 18°51.63'S, 168°50.98'E, 980-990 m, 24.09.1994: 1 male specimen 59.9 mm HL, 339+ mm TL (MNHN 1995-995).

Norfolk Ridge. HALIPRO 2: stn BT 42, 25°41'S, 167°11'W, 1132-1160 m, 15.11.1996: 1 specimen 68.7 mm HL, 453 mm TL (CAS 90683).

Indeterminate specimens:

Vanuatu. MUSORSTOM 8: stn CP 1075, 15°53.81'S, 167°30.42'E, 1100-1191 m, 4.10.1994: 1 specimen 24.9 mm HL, 142 mm TL (MNHN 1995-952).

New Caledonia. BATHUS 1: stn CP 660, 21°10.48'S, 165°53.19'E, 790 m, 13.03.1993: 1 male specimen 26.8 mm HL, 151 mm TL (MNHN 1995-810).

DESCRIPTION (not including the two indeterminate specimens). — *Counts*: 1D. II,9; 1P. i18-i19; V. 8; GR-I (outer) 5+23.

REMARKS. — The larger two of our four specimens (CAS 90683 and MNHN 1995-995) agree well with our concept of *G. introniger*, as does one of similar size recorded by IWAMOTO & MERRETT (1997: 480; MNHN 1997-656) from the Matthew and Hunter Islands. The recent two specimens, however, have gill rakers that are sharply tipped (in contrast to bluntly tipped in MNHN 1997-656). The two juveniles we list as indeterminate differ from *G. introniger* in having a broader internasal (23-26% HL), larger orbit (24-28% HL), narrower suborbital (12% HL), longer upper jaw (61% HL), longer barbel (59-76% HL), and longer gill rakers (18-19% HL). The high pyloric caeca count (60) of IWAMOTO & MERRETT's (1997) indeterminate specimen from the Chesterfield and Bellona Plateau contrasts with the 20 in MNHN 1997-656 and the 24 of the HALIPRO 2 specimen (counts of the other specimens were not taken). A good size series would probably help in resolving the identity of these problematical specimens.

Family MACROURIDAE

Subfamily MACROURINAE

Genus ***CAELORINCHUS*** Giorna, 1810

Caelorinchus acutirostris Smith & Radcliffe, 1912

Caelorinchus acutirostris - IWAMOTO & MERRETT, 1997: 485-486, Fig. 6a (New Caledonia, Philippines, Australia).

MATERIAL EXAMINED. — 2 specimens.

New Caledonia. BATHUS 1: stn CP 657, 21°14.45'S, 165°54.93'E, 490-530 m, 12.03.1993: 1 specimen 25 mm HL (MNHN 1995-820).

Vanuatu. MUSORSTOM 8: stn CP 1136, 15°40.62'S, 167°01.60'E, 398-400 m, 11.10.1994: 1 specimen 43 mm HL (MNHN 1995-870).

REMARKS. — This is an upper-slope species of tropical seas known from New Caledonia (22°S), Vanuatu, Philippines, and Queensland, Australia (09°53'S). It was not taken during HALIPRO 2. The BATHUS 1 capture is the deepest record.

Source : MNHN, Paris

Caelorinchus anatirostris Jordan & Gilbert, 1904

Caelorinchus anatirostris - IWAMOTO & MERRETT, 1997: 486-489, Fig. 6c (New Caledonia, Chesterfield & Bellona Plateau).

MATERIAL EXAMINED. — 7 specimens.

Vanuatu. MUSORSTOM 8: stn CP 1050, 16°39.20'S, 168°01.30'E, 541-577 m, 1.10.1994: 2 specimens 85-86 mm HL, 330+-331+ mm TL (MNHN 1995-888). — Stn CC 1056, 16°33.11'S, 167°55.64'E, 602-620 m, 1.10.1994: 1 specimen 107 mm HL, 355+ mm TL (MNHN 1995-835), 1 specimen 67 mm HL, 265+ mm TL (MNHN 1997-698). — Stn CP 1124, 15°57.63'S, 166°38.43'E, 1160-1120 m, 9.10.1994: 1 specimen 120 mm HL, 450+ mm TL (MNHN 1995-878).

New Caledonia. BATHUS 1: stn CP 671, 20°51.18'S, 165°28.17'E, 450-470 m, 14.03.1993: 2 specimens 76-83 mm HL, 300-300+ mm TL (MNHN 1995-827).

REMARKS. — These specimens are slightly larger than ones previously examined from the region and expand the range of several measurements and counts in the species. The maximum size is now known to exceed 45 cm TL and 120 mm HL. Other increases in range of counts are seen in scale rows below mid-1D.(3-5), lateral line scales over distance equal to predorsal length (30-34), and number of pyloric caeca (30-32). Changes in the range of mensural characters include: preoral length (28-37% HL), distance orbit to preopercle (32-39% HL), length upper jaw (21-31% HL), height 1D. (38-53% HL), and posterior nostril (8-11% HL). Additionally, the largest specimen (MNHN 1995-878, 120 mm HL) has a completely naked nasal fossa, whereas all other specimens have a mostly scaled nasal fossa.

Caelorinchus argentatus Smith & Radcliffe, 1912

Caelorinchus argentatus - IWAMOTO & MERRETT, 1997: 489-490, Fig. 6b (New Caledonia, Australia).

MATERIAL EXAMINED. — 15 specimens.

Vanuatu. MUSORSTOM 8: stn CP 973, 19°21.30'S, 169°27.03'E, 460-480 m, 22.09.1994: 1 specimen 53 mm HL (MNHN 1995-980). — Stn CP 974, 19°21.51'S, 169°28.26'E, 492-520 m, 22.09.1994: 4 specimens 52-77 mm HL (MNHN 1995-864). — Stn CP 975, 19°23.60'S, 169°28.93'E, 566-536 m, 22.09.1994: 1 specimen 66 mm HL (MNHN 1995-863). — Stn CP 980, 19°21.02'S, 169°25.22'E, 450-433 m, 22.09.1994: 3 specimens 34-93 mm HL (MNHN 1995-833). — Stn CP 982, 19°21.80'S, 169°26.47'E, 408-410 m, 23.09.1994: 1 specimen 54 mm HL (MNHN 1995-872). — Stn CP 983, 19°21.61'S, 169°27.76'E, 480-475 m, 23.09.1994: 1 specimen 63 mm HL (MNHN 1995-849). — Stn CP 984, 19°19.62'S, 169°26.43'E, 480-544 m, 23.09.1994: 3 specimens 62-87 mm HL (MNHN 1995-887). — Stn CP 1136, 15°40.62'S, 167°01.60'E, 398-400 m, 11.10.1994: 1 specimen 64 mm HL (MNHN 1995-870).

REMARKS. — Our specimens of *Caelorinchus argentatus* from the Vanuatu region differed somewhat from those taken on earlier cruises. They, in fact, agreed more with the type specimens from the Sulu Sea in having a slightly shorter snout (39-42% HL *cf.* 44-45% in New Caledonia material), shorter preoral (31-35% *cf.* 36-38%), slightly wider interorbital space (25-27% *cf.* 24-25%), slightly larger orbit (27-28% *cf.* 24-26%), shorter barbel (9-11% *cf.* 11-13%), higher first dorsal fin (47-54% *cf.* 33-44%), and fewer lateral line scales over a distance equal to predorsal length (40-43% *cf.* 47-48%). In addition, the Vanuatu specimens were decidedly darker overall, although the difference was a matter of degree rather than that of pattern. We previously (IWAMOTO & MERRETT, 1997: 490) attributed the differences found between New Caledonian and Sulu Sea specimens as reflecting individual variation and small sample size. Our current thinking on this matter has not changed.

Caelorinchus argentatus is apparently a tropical species and was not taken during the HALIPRO 2 cruise to regions south of New Caledonia. In previous MUSORSTOM cruises, the species was never taken south of 22°S and no deeper than 460 m. The specimen from CP 975 extends the maximum depth range to 536-566 m.

Caelorinchus celaenostomus McMillan & Paulin, 1993

Caelorinchus celaenostomus - IWAMOTO & MERRETT, 1997: 490-493, Fig. 7 (Norfolk Ridge).

Source : MNHN, Paris

MATERIAL EXAMINED. — 9 specimens.

Loyalty Ridge. HALIPRO 2: stn BT 3, 23°31.15'S, 169°36.54'E, 685-831 m, 6.11.1996: 1 specimen 172 mm HL, 555+ mm TL (MNHN 1998-237).

Norfolk Ridge. HALIPRO 2: stn BT 32, 25°19.93'S, 168°56.56'E, 697-1340 m, 12.11.1996: 1 specimen 143 mm HL, 520 mm TL (CAS 90982), 1 specimen (MNHN 1998-322). — Stn BT 34, 25°23.03'S, 168°56.47'E, 643-1233 m, 12.11.1996: 1 specimen 116 mm HL, 320 mm TL (CAS 90670), 1 specimen 149 mm HL, 515+ mm TL (BMNH 1997.5.21:35). — Stn BT 35, 25°23'S, 168°56.99'E, 640-740 m, 12.11.1966: 1 specimen (MNHN 1998-235), 1 specimen 116 mm HL, 310 mm TL (CAS 90984), 1 specimen 127 mm HL, 410+ mm TL (BMNH 1997.5.21:39). — Stn BT 91, 23°13.86'S, 167°57.19'E, 650-660 m, 23.11.1996: 1 specimen 188 mm HL, 710 mm TL (BMNH 1997.5.21:63).

REMARKS. — The three CAS specimens were previously recorded by IWAMOTO & MERRETT (1997: 490-493). *Caelorinchus celaenostomus* attains at least 83 cm TL. It was taken occasionally off the Norfolk Ridge and once on the Loyalty Ridge. It is distributed in New Zealand waters north of Cook Strait (about 41°30'S), and although found off the Challenger Plateau, it does not occur on the Chatham Rise (McMILLAN & PAULIN, 1993). The northern record is from HALIPRO 2 station BT 91 at latitude 23°S. Depth range 606-1383 m.

Caelorinchus cingulatus Gilbert & Hubbs, 1920

Caelorinchus cingulatus - IWAMOTO & MERRETT, 1997: 493-495, Fig. 8 (New Caledonia, Loyalty Islands, Wallis & Futuna Islands, Australia).

MATERIAL EXAMINED. — 5 specimens.

Vanuatu. MUSORSTOM 8: stn CP 973, 19°21.30'S, 169°27.03'E, 460-480 m, 22.09.1994: 1 specimen 55 mm HL (MNHN 1997-697). — Stn CP 1027, 17°53.05'S, 168°39.35'E, 550-571 m, 28.09.1994: 2 specimens 22-49 mm HL (MNHN 1995-847). — Stn CP 1049, 16°39.43'S, 168°02.97'E, 469-525 m, 1.10.1994: 1 specimen 55 mm HL (MNHN 1995-852).

New Caledonia. BATHUS 1: stn CP 702, 20°55.97'S, 165°34.67'E, 591-660 m, 18.03.1993: 1 specimen 54 mm HL (MNHN 1995-815).

REMARKS. — This species was not collected during HALIPRO 2 and presumably is more tropical in distribution than many taken during that cruise. It is now known from off New Caledonia, Loyalty Islands, Vanuatu, Wallis and Futuna Islands, and the east coast of Australia, where it has been recorded as far south as 28°S near the Queensland/New South Wales border.

Caelorinchus cylindricus Iwamoto & Merrett, 1997

This species is known only from the holotype taken on Seamount B on the Norfolk Ridge southeast of New Caledonia in 550-920 m. No specimens were collected during HALIPRO 2, although Seamount B was sampled during that cruise.

Caelorinchus kermadecus Jordan & Gilbert, 1904

Fig. 11

Caelorinchus kermadecus - IWAMOTO & MERRETT, 1997: 496-499, Fig. 10 (Norfolk and Loyalty Ridges). — GRANDPERRIN *et al.*, 1997: 117 (New Caledonia; list).

MATERIAL EXAMINED. — 45 specimens.

Norfolk Ridge. HALIPRO 2: stn BT 02, 23°17.54'S, 167°51.36'E, 1025-1049 m, 5.11.1996: 1 specimen 94 mm HL, 305+ mm TL (CAS 90959), 1 specimen 101 mm HL (CAS 90690), 3 specimens 103-163 mm HL, 325+-560+ mm TL (MNHN 1998-2234). — Stn BT 38, 24°55.69'S, 168°19.9'E, 856-1450 m, 13.11.1996: 1 specimen 136 mm HL, 410+ mm TL (MNHN 1998-323). — Stn BT 41, 25°47.77'S, 167°11.52'E, 1317-1383 m, 14.11.1996: 1 specimen 146 mm HL, 525+ mm TL (BMNH 1997.5.21:61). — Stn BT 42, 34°29'S, 167°25.08'E, 1132-1160 m, 15.11.1996: 1 specimen (CAS 90985). — Stn BT 64, 24°41.54'S, 168°40.88'E, 800-1240 m, 19.11.1996: 1 specimen 128 mm HL 462 mm TL (CAS 91028). — Stn BT 66, 24°43.92'S, 168°28.78'E, 885-1450 m, 19.11.1996: 1 specimen 163 mm HL, 500+ mm TL (CAS

Source : MNHN, Paris

uncat.). — Stn BT 69, 24°40.34'S, 168°08.9'W, 943-1080 m, 20.11.1996: 2 specimens (MNHN 1998-236). — Stn BT 75, 24°13.17'S, 167°36.52'E, 1128-1150 m, 21.11.1996: 1 specimen 77 mm HL, 200+ mm TL (CAS 90615). — Stn BT 76, 24°05.43'S, 167°34.29'E, 936-940 m, 21.11.1996: 3 specimens (CAS 90743), 16 specimens (NMNZ P.34019).

Loyalty Ridge. HALIPRO 2: stn BT 14, 24°18.66'S, 170°00.6'E, 909-1160 m, 8.11.1996: 1 specimen 119 mm HL, 412+ mm TL (CAS 90985), 1 specimen (MNHN 1998-234). — Stn BT 15, 24°36.28'S, 170°03.85'E, 900-1005 m, 8.11.1996: 4 specimens 121-170 mm HL, 430+-595+ mm TL (MNHN 1998-316). — Stn BT 18, 24°34.42'S, 170°1.62'E, 1050-1290 m, 9.11.1996: 1 specimen 120 mm HL, 390+ mm TL (CAS 90986).

Lord Howe Rise. HALIPRO 2: stn BT 97, 24°00.16'S, 161°46.22'E, 964-1031 m, 25.11.1996: 3 specimens (NMNZ P.34016), 3 specimens (NMNZ P.34017).

REMARKS. — *Caelorinchus kermadecus* was one of the most often-captured species of grenadier during the HALIPRO 2 cruise (Fig. 11), and it was one that caused considerable identification problems because of the amount of variation seen in snout length and scale spinulation. A few specimens were confused with the closely similar *C. mycterismus*, which has a generally longer, more-upturned snout (45-55% HL *cf.* 41-47% in *C. kermadecus*), shorter first dorsal fin height (28-36% HL *cf.* 36-43%), shorter upper jaw (15-25% *cf.* 25-30%), and shorter postorbital length (25-30% *cf.* 34-36%). The orbit goes into the postorbital length about 1.2-1.5 times in *C. kermadecus* but only 0.9-1.3 times in *C. mycterismus*. Also, the anal fin in *C. kermadecus* is dark posteriorly, whereas in *C. mycterismus* it is usually paler over the posterior third. The species is one of the members of the genus attaining large adult size (58+ cm TL).

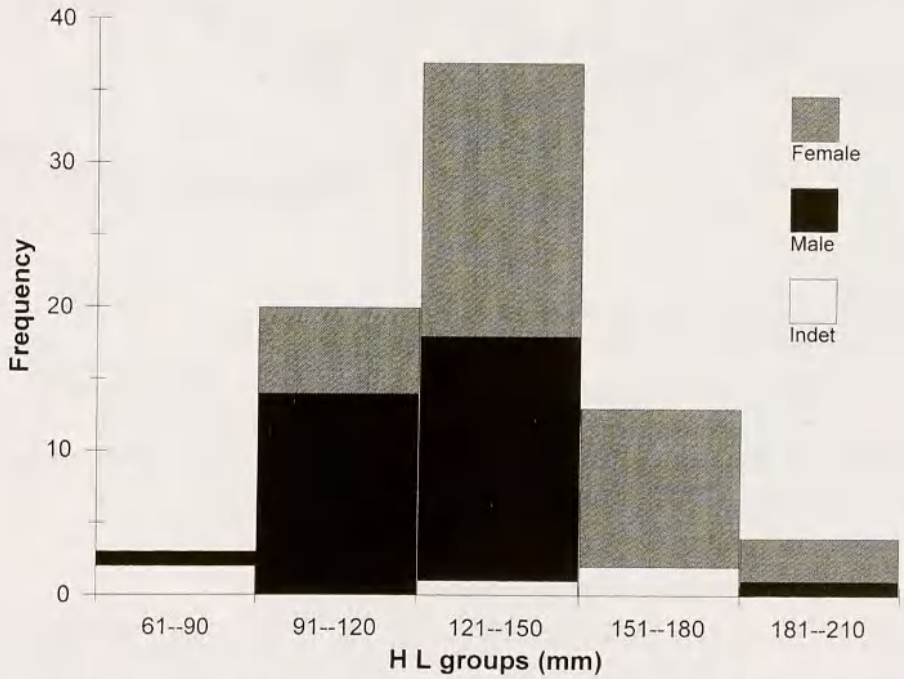

FIG. 11. — Length-frequency (HL, head length mm) distribution of *Caelorinchus kermadecus* by sex (n = 77).

Caelorinchus melanobranchus Iwamoto & Merrett, 1997

No specimen of this interesting species of small adult size was collected during recent MUSORSTOM cruises.

Caelorinchus mycterismus McMillan & Paulin, 1993

Fig. 12

Caelorinchus mycterismus McMillan & Paulin, 1993: 827-829, Fig. 6 (holotype Challenger Plateau, New Zealand, 846-875 m; 30 paratypes).

Source : MNHN, Paris

MATERIAL EXAMINED. — 1 specimen.

Loyalty Ridge. HALIPRO 2: stn BT 23, 25°04.95'S, 170°11.7'E, 1105-1360 m, 10.11.1996: 1 specimen 152 mm HL, 455+ mm TL (CAS 90994).

DIAGNOSIS. — Underside of head completely scaled; nasal fossa scaled; snout 45-51% HL; anterolateral margin of snout incompletely supported by bone; body scales with broad spinules in about 5-7 more or less parallel rows, the median row highest, formed of 4-7 closely adpressed spinules, flanked above and below by 3-6 shorter, lower rows, some of which consist of only 1 or 2 small, narrow spinules at anterior end of exposed field, large spinules with high transverse buttresses interconnected in some to form transverse ridges running perpendicular to spinule rows; light organ lacking external fossa; anal fin dusky to blackish anteriorly, paler at posterior end. Scales below 2D. 5-7; height 1D. 28-36% HL.

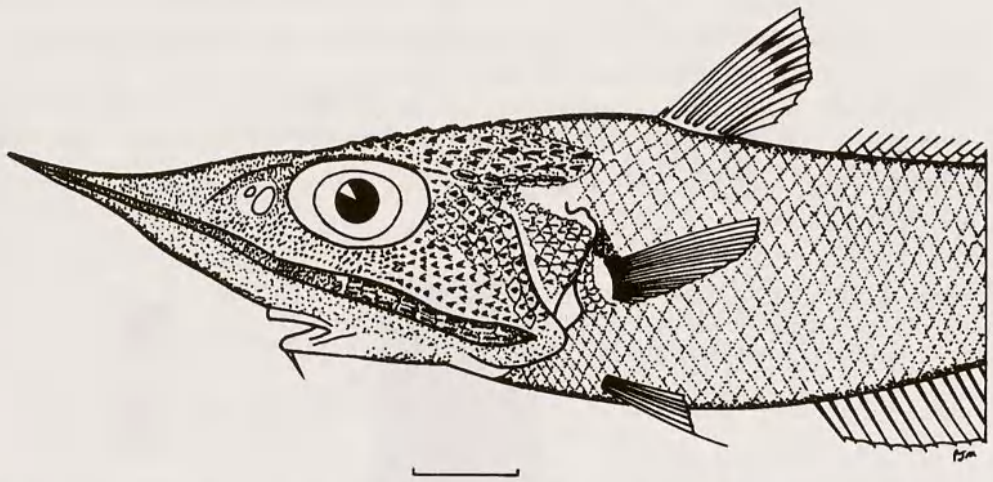

FIG. 12. — *Caelorinchus mycterismus* McMillan & Paulin, 1993. Lateral view of head and trunk of holotype (NMNZ P.23003). From MCMILLAN & PAULIN, 1993, fig. 6. Used with permission of the ASIH.

REMARKS. — This species, which attains large adult size (49+ cm TL), is reported to be abundant off New Zealand, especially around North Island and the Challenger Plateau, in depths of 833-1150 m (MCMILLAN & PAULIN, 1993: 829). The HALIPRO 2 specimen is the northernmost record of the species. *Caelorinchus mycterismus* is most likely to be confused with *C. kermadecus*; see Remarks under that species for a comparison.

Caelorinchus parallelus Günther, 1877

Caelorinchus parallelus - IWAMOTO & MERRETT, 1997: 500-502, Fig. 12 (Chesterfield & Bellona Plateau, Japan). — GRANDPERRIN *et al.*, 1997: 117 (New Caledonia; list).

MATERIAL EXAMINED. — 5 specimens.

Vanuatu. MUSORSTOM 8: stn CC 996, 18°52.41'S, 168°55.73'E, 764-786 m, 24.09.1994: 2 specimens (MNHN 1997-669).

Norfolk Ridge. HALIPRO 2: stn BT 2, 23°17.54'S, 167°51.36'E, 1025-1049 m, 5.11.1996: 1 specimen 65 mm HL, 191+ mm TL (CAS 204499). — Stn BT 90, 23°16.98'S, 168°08.38'E, 975-987 m, 23.11.1996: 1 specimen 109 mm HL, 360+ mm TL (BMNH 1997.5.21.41).

Lord Howe Rise. HALIPRO 2: stn BT 104, 25°23,01'S, 162°35.4'E, 1118-1124 m, 27.11.1996: 1 specimen 103 mm HL, 349+ mm TL (CAS 90987).

REMARKS. — We had previously recorded the species from two specimens collected off the Chesterfield and Bellona Plateau. These additional specimens from Vanuatu, the Norfolk Ridge, and the Lord Howe Rise extend the range latitudinally and to the east. The small HALIPRO 2 specimen from the Norfolk Ridge was collected along with several larger specimens of *C. kermadecus* and was initially confused with that species. The absence of scales

Source : MNHN, Paris

on the nasal fossa, the relatively extensive naked areas along the suborbital shelf, the wider spacing between scales on the underside of the head, the crestlike rows of spinules on the dorsal surface of the snout and between the orbits, and the paler fins of that specimen differentiate it from *C. kermadecus*.

Caelorinchus platorhynchus Smith & Radcliffe, 1912

Caelorinchus platorhynchus - IWAMOTO & MERRETT, 1997: 502-503, Fig. 13 (Loyalty Islands).

MATERIAL EXAMINED. — 1 specimen.
Loyalty Ridge. HALIPRO 2: stn BT 3, 23°31.15'S, 169°36.54'E, 685-831 m, 6.11.1996: 1 specimen 70 mm HL, 220+ mm TL (MNHN 1998-233).

REMARKS. — A single juvenile of this rarely-caught species was taken during the HALIPRO 2 cruise.

Caelorinchus semaphoreus Iwamoto & Merrett, 1997

Caelorinchus semaphoreus Iwamoto & Merrett, 1997: 503-505, Fig. 14 (New Caledonia and Qld, Australia; 420-445 m).

This species is known from 30 specimens collected at three sites off Queensland, Australia, and one specimen taken off New Caledonia. It was not represented in current collections.

Caelorinchus sereti Iwamoto & Merrett, 1997

Caelorinchus sereti Iwamoto & Merrett, 1997: 505-507 (New Caledonia, Loyalty Islands, Chesterfield & Bellona Plateau).

MATERIAL EXAMINED. — 29 specimens.
Vanuatu. MUSORSTOM 8: stn CP 992, 18°52.34'S, 168°55.16'E, 775-748 m, 24.09.1994: 1 specimen 124 mm HL (MNHN 1995-831). — Stn CP 994, 18°47.72'S, 168°56.17'E, 649-641 m, 24.09.1994: 4 specimens 27-97 mm HL (MNHN 1995-841), 1 specimen 104 mm HL (MNHN 1995-845). — Stn CC 996, 18°52.41'S, 168°55.73'E, 764-786 m, 24.09.1994: 1 specimen 116 mm HL (MNHN 1995-832), 1 specimen 122 mm HL (MNHN 1995-840), 1 specimen 112 mm HL (MNHN 1995-844), 1 specimen 94 mm HL (MNHN 1995-861), 1 specimen 125 mm HL (MNHN 1995-879), 1 specimen 89 mm HL (MNHN 1995-884). — Stn CP 1007, 18°51.97'S, 168°55.92'E, 720-830 m, 25.09.1994: 1 specimen 115 mm HL (MNHN 1995-883) and 2 specimens 44-94 mm HL (MNHN 1995-965). — Stn CP 1074, 15°48.42'S, 167°24.27'E, 775-798 m, 4.10.1994: 1 specimen 141 mm HL (MNHN 1995-876). — Stn CP 1124, 15°01.7'S, 166°56.51'E, 532-599 m, 9.10.1994: 1 specimen 19 mm HL (MNHN 1997-693).
New Caledonia. BATHUS 1: stn CP 658, 21°13.45'S, 165°55.12'E, 515-580 m, 12.03.1993: 3 specimens 16-83 mm HL (MNHN 1995-809). — Stn CP 671, 20°51.18'S, 165°28.17'E, 450-470 m, 14.03.1993: 2 specimens 18-83 mm HL (MNHN 1997-690).
Stn unknown: 5 specimens 57.2-95.1 mm HL, 165+-325+ mm TL (MNHN 1995-825). — Stn unknown: 2 specimens 53.5-88 mm HL (MNHN 1995-988).

REMARKS. — *Caelorinchus sereti* was one of the more frequently encountered species, having been captured in 14 trawls. The smallest specimens (less than about 60 mm) we examined were juveniles; they had three saddle marks posteriorly, the first behind and below the origin of the second dorsal fin. Their snout was more acute, sharper pointed, and relatively longer than in adults; the scale covering was also thinner and more scattered, especially on the snout surfaces, and the nasal fossa was for the most part naked (scaled in adults).

The species has not been taken south of New Caledonia and so far appears to be confined to the immediate vicinity of New Caledonia, Loyalty Islands, Vanuatu, and the Chesterfield and Bellona Plateau, in depths of 412-830 m.

Caelorinchus shcherbachevi Iwamoto & Merrett, 1997

Caelorinchus shcherbachevi Iwamoto & Merrett, 1997: 507-509, Fig. 13b (Loyalty Ridge).
Caelorinchus sp. n. - GRANDPERRIN *et al.*, 1997: 117 (New Caledonia; list).

Source : MNHN, Paris

MATERIAL EXAMINED. — 2 specimens.
Loyalty Ridge. HALIPRO 2: stn BT 13, 24°18.03'S, 169°57.5'E, 805-835 m, 8.11.1996: 1 specimen 122 mm HL 435+ mm TL (paratype, CAS 90995), 1 specimen 132 mm HL, 550 mm TL (MNHN 1998-318).

REMARKS. — This rarely-caught species is known from only four specimens taken in two trawls on the Loyalty Ridge. One of the HALIPRO 2 specimens is a paratype, previously recorded by IWAMOTO & MERRETT (1997: 507).

Caelorinchus spathulatus McMillan & Paulin, 1993

Caelorinchus spathulata McMillan & Paulin, 1993: 832-833, Fig. 9 (New Zealand).
Caelorinchus spathulatus - IWAMOTO & MERRETT, 1997: 509-511, Fig. 16 (New Caledonia, Chesterfield and Bellona Plateau, New Zealand, Australia [Qld.] in 550-825 m).

No specimen of this species was collected during recent cruises.

Caelorinchus supernasutus McMillan & Paulin, 1993

Fig. 13

Caelorinchus supernasutus McMillan & Paulin, 1993: 833-835, Fig. 10 (holotype NMNZ P.22641, Bay of Plenty, New Zealand, 606-673 m). — GRANDPERRIN *et al.*, 1997: 117 (New Caledonia; listed).

MATERIAL EXAMINED. — 1 specimen.
Norfolk Ridge. HALIPRO 2: stn BT 35, 25°23'S, 168°56.99'E, 640-740 m, 12.11.1996: 1 specimen 136 mm HL, 440 mm TL (MNHN 1998-231).

DIAGNOSIS. — Snout extremely long, 50-55% HL; underside of head completely scaled; nasal fossa scaled; anterolateral snout margin completely supported by bone; a small, prominent dermal window of light organ before anus extending anteriorly to about midway between anal fin origin and pelvic fin insertion; body scales with 5-8 divergent rows of spinules; anal fin dusky, paler along base.

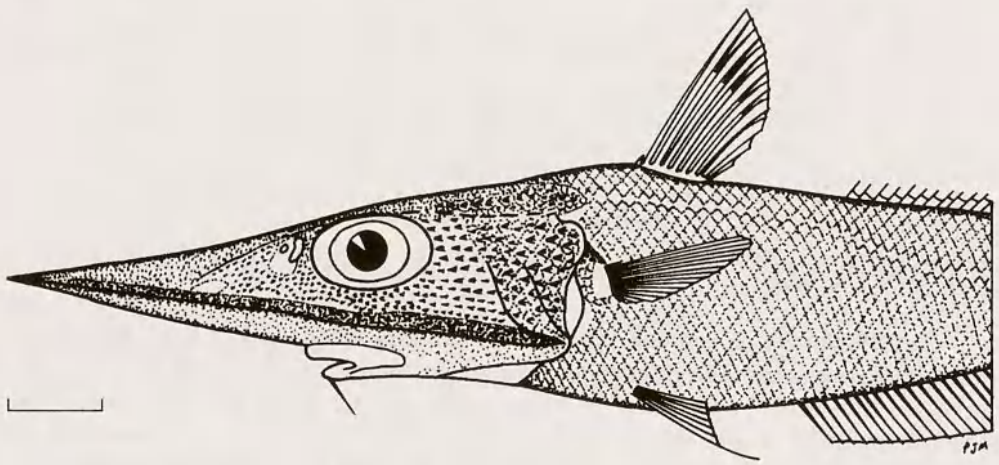

FIG. 13. — *Caelorinchus supernasutus* McMillan & Paulin, 1993. Lateral view of head and trunk of holotype (NMNZ P.22641). From MCMILLAN & PAULIN, 1993, fig. 10. Used with permission of the ASIH.

DESCRIPTION (one specimen). — *Counts*: 1D. II,8; P. I15; scales below 1D. 8, mid-base 1D. 5, 2D. 7.5, lat. line 55. *Measurements* (in mm, percent HL in parentheses): snout 71 (52); preoral 67 (49); interob. 22 (16); orb. 32 (24); suborb. 15 (11); postorb. 33 (24); orb.-preop. 34.5 (25); up. jaw 28 (21); barbel 11 (8); isthm.-A. 67 (49); pre-A. 193 (142); len. V. 31 (23).

Source : MNHN, Paris

Scales small, armed with 5-8 (or more) short, slightly divergent or subparallel, comblike rows of erect spinules.

SIZE. — To at least 64 cm TL.

DISTRIBUTION. — Restricted to northern New Zealand (north of 37°S) and the Norfolk Ridge (to about 25°S), in about 640-750 m.

REMARKS. — See the original description for details and illustration. *Caelorinchus supernasutus* is apparently common off North Island, New Zealand (McMILLAN & PAULIN, 1993: 835) but is probably marginal to the New Caledonia EEZ, where the current specimen is first recorded from the region. The species attains relatively large adult size (*ca* 64 cm TL). It is similar to *C. sereti* in many fundamental respects, and will key out to that species in IWAMOTO & MERRETT's (1997: 484-485) key to the species of *Caelorinchus* from New Caledonia. However, *C. supernasutus* has among other characters a considerably longer snout (50-55% HL *cf.* 38-46% in *C. sereti*) and body scales with spinules more erect and forming more comblike ridges, the ridge rows less divergent than in *C. sereti*.

Caelorinchus trachycarus Iwamoto, McMillan & Shcherbachev, 1999

Fig. 14

Caelorinchus sp. n. Iwamoto & Merrett - GRANDPERRIN *et al.*, 1997: 117 (New Caledonia; list).
Caelorinchus trachycarus Iwamoto, McMillan & Shcherbachev, 1999: 49-54 (New Zealand, Norfolk Ridge, Australia, in 622-1350 m).
Caelorinchus trachycarus - IWAMOTO & WILLIAMS, 1999: 166-167 (Southern Australia to New Zealand in 1015-1234 m).

MATERIAL EXAMINED. — 1 specimen.
Norfolk Ridge. HALIPRO 2: stn BT 77, 24°11.38'S, 167°45.52'E, 1349-1350 m, 21.11.1996: 1 paratype 107 mm HL, 412 mm TL (CAS 90983).

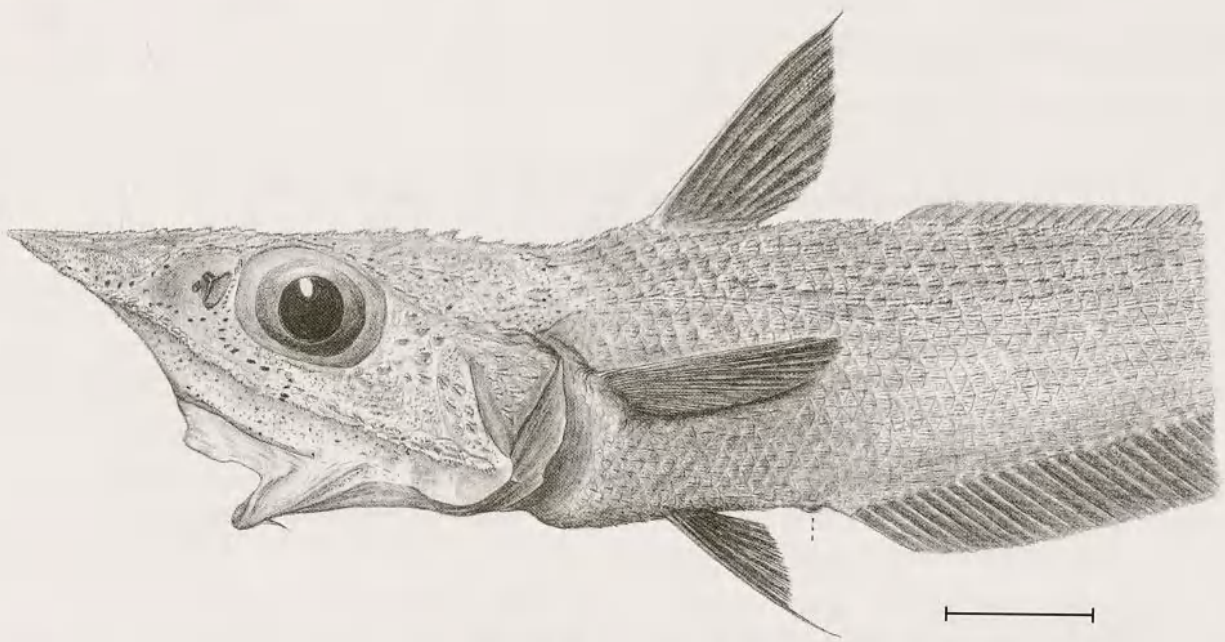

FIG. 14. — *Caelorinchus trachycarus* Iwamoto, McMillan & Shcherbachev, 1999. Lateral view of head and trunk of paratype (AMS I.18712-015; 350+ mm TL) from off southern Australia. Scale = 25 mm. From IWAMOTO & WILLIAMS, 1999, fig. 24. Used with permission of the California Academy of Sciences.

Source : MNHN, Paris

DIAGNOSIS. — Underside of head scaled; nasal fossa naked; anterolateral snout margin incompletely supported by bone; scales of head ridges markedly spiny and coarsely modified; body scales with numerous (8 or more) parallel spinule rows, the median row complete to edge of scale and slightly larger than incomplete, small, short, lateral rows of spinules; light organ lacking external fossa; anus immediately anterior to anal fin; fins black; overall color dark, generally swarthy with purplish tinge.

DESCRIPTION (of one specimen). — *Counts*: 1D. II,8; P. i,17-i,18; scales below 1D. 5, mid-base 1D. 4.5, 2D. 5.5, lat. line 30. *Measurements* (in mm, percent HL in parentheses): snout 47 (44); preoral 43 (40); internasal 22 (21); interorb. 26 (24); orb. 28 (26); suborb. 19 (17); postorb. 33 (31); orb.-preop. 35 (32); up. jaw 24 (22); barbel 7 (7); V.-A. 42 (39); isthm.-A. 68 (64); pre-A. 167 (156); body depth 55 (51); 1D.-2D. interspace 26 (24); ht. 1D. 47 (44); len. P. 38 (36); len. V. 38 (36).

SIZE. — To about 50 cm TL.

DISTRIBUTION. — Common off New Zealand and the southern coast of Australia, from New South Wales to Western Australia.

REMARKS. — The single HALIPRO 2 specimen from the Norfolk Ridge represents the northernmost record of the species. In the New Caledonian region the species most closely resembles *C. kermadecus*, but it can be readily distinguished from that species by its naked nasal fossa, much darker overall color with purplish tinge in unscaled areas, wholly black fins, and much coarser and more spiny head ridges, and the presence of many more parallel and lower spinule rows on body scales.

Genus ***CETONURICHTHYS*** Sazonov & Shcherbachev, 1982

Head inflated, broad (interorbital width about one-third HL), soft, lacking stout ridges, covered with small, fine scales, including lower jaw and over lower branchiostegal rays. Snout high, tipped with two small tubercular scales; suborbital region deep, about 17-20% HL; jaws short (24-28% HL), inferior. Periproct small; anus about midway between anal and pelvic fin bases; no discernible light organ. Pelvic fins posterior to vertical through origin of first dorsal and pectoral fin bases. Body scales small, about 11-13 below 1D. origin; lateral line interrupted into a series of dashes. Only one species.

Cetonurichthys subinflatus Sazonov & Shcherbachev, 1982

Fig. 15

Cetonurichthys subinflatus Sazonov & Shcherbachev, 1982: 9, Fig. 3 (holotype, ZMMGU P.15296, and two paratypes, ZMMGU P.15297, northwest coast of Australia, 1600-1700 m). — GRANDPERRIN *et al.*, 1997: 117 (New Caledonia; list).

MATERIAL EXAMINED. — 1 specimen.

Norfolk Ridge. HALIPRO 2: stn 68, 24°48.20'S, 168°17.12'E, 1316-1564 m, 19.11.1966; 1 specimen 71.2 mm HL, 372+ mm TL (MNHN 1998-239).

DIAGNOSIS. — Pelvic fin rays 8 or 9; P. i16-i18; scale rows below 1D. 11-14, below 2D. 10-13; interorbital 29-33% HL; second spinous dorsal ray about 70-98% HL.

DESCRIPTION (of Vanuatu specimen). — *Counts*: 1D. II,9; P. i16/i16; V. 8/9; scale rows 1D. about 13 or 14, below mid-1D. 8.5, below 2D. 10, lateral line over pre-1D. length about 50.

Measurements: Total length 372 mm (tip partly missing), HL 71.2 mm. The following in millimeters followed in parentheses by percent HL: snout 28 (39); preoral 23 (32); internasal 21 (29); interorb. 21 (29); orb. 16 (22); suborb. 14.3 (20); postorb. 28 (39); orb.-preop. 27.5 (39); up.jaw 19 (27); barbel 7 (10); body depth 62

Source : MNHN, Paris

(87); pre-A. 115 (162); pre-vent 104 (146); V.-A. 24 (34); isthm.-A. 52 (73); ht. 1D. 70+ (98); len. P. 41 (58); len. V. 40 (56).

See SAZONOV and SHCHERBACHEV (1982) for a good description of this species and diagnosis of the genus.

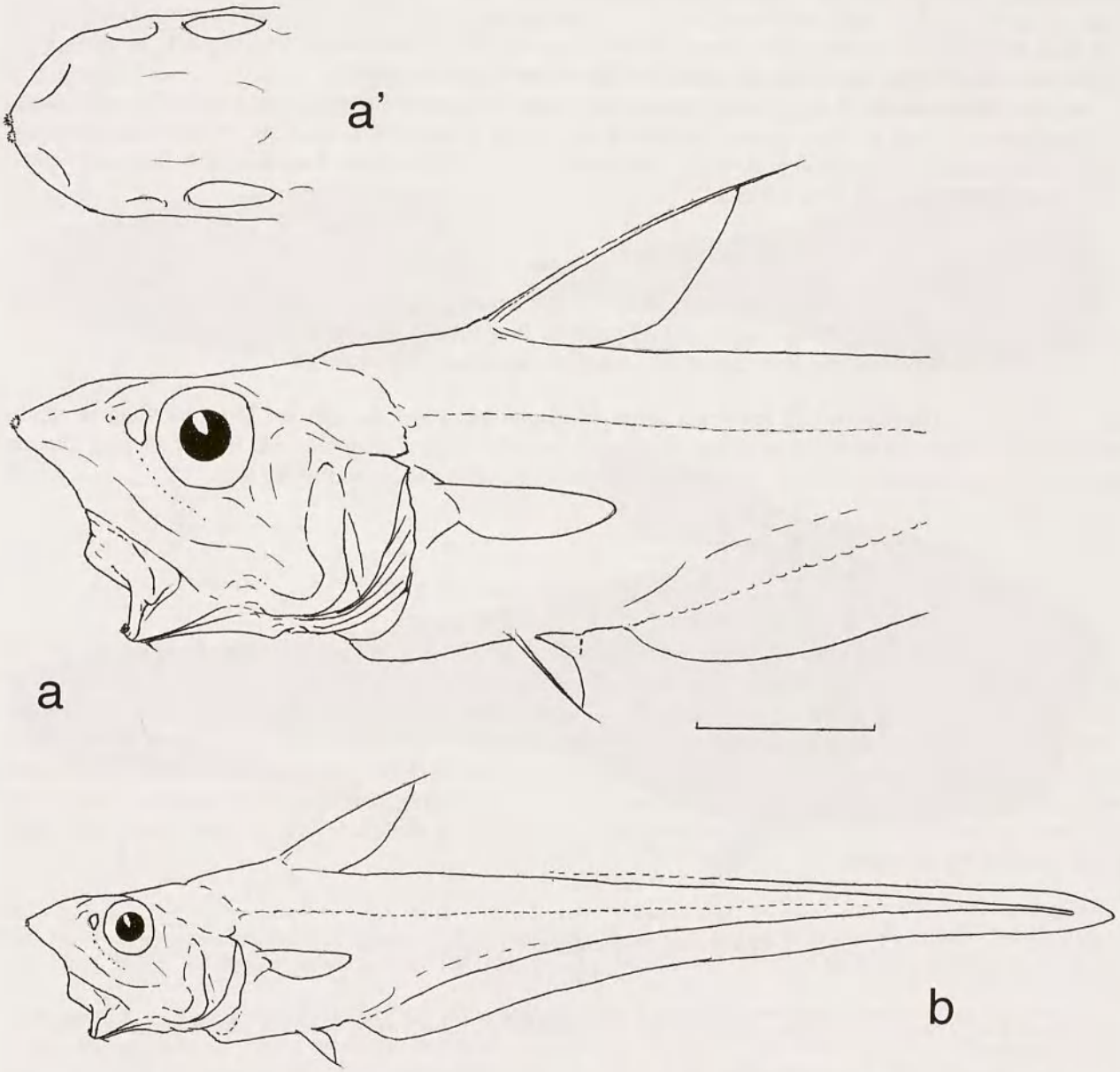

FIG. 15. — *Cetonurichthys subinflatus* Sazonov & Shcherbachev, 1982. Diagrammatic views of paratype (ZIL P.15297) from off northwestern Australia: (**a**) lateral view of head and trunk; (**a'**) dorsal view of snout; (**b**) lateral view of entire fish. Scale for (a) and (a') = 25 mm.

General features of fish seen in Fig. 15. Head large, rounded contours, without stout or sharp ridges; snout broad, moderately pointed, tipped with two distinctly separated tubercular scales; mouth small, subinferior, rictus restricted by lip folds at posterior angle. Periproct region moderately broad, but no external indication of light organ; anus located about equidistant from insertion of pelvic fins and origin of anal fin. No large naked papillae or free neuromasts, nor connecting naked lines along suborbital shelf. Neuromasts under head small, black.

Source : MNHN, Paris

Entire underside of head scaled, including fully scaled mandibular ramus, interopercle, preopercle, subopercle, and opercle. Extent of squamation similar to that in *Cetonurus*, with no naked margins. Gular and branchiostegal membranes heavily covered with small scales. Lateral line incomplete, consisting of a series of dashed grooves. Scales over most of head and body covered with spinules that are very slender, conical, upright, bristly, with recurved tips, not in any distinct or readily discernible arrangement, but perhaps in somewhat parallel rows. Scales along second dorsal fin slightly enlarged, but not strikingly so as in *Cetonurus* and *Trachonurus*. Premaxillary teeth band broad, short; greatest width about one-third length of band. Mandibular band similarly broad or even broader, and short but tapered posteriorly (greatest width about twice into length).

Fins well developed; first dorsal high, the second spinous ray armed along leading edge with small, sharp, spaced serrations. Outer pelvic ray weak, extending posteriorly to about fifth anal ray. Pelvic fins posteriorly placed on abdomen, about under first dorsal fin; distance between pelvic and anal fins short; anal fin origin behind vertical through hind margin of first dorsal.

SIZE. — To about 37 cm TL.

DISTRIBUTION. — Known previously only from the type series (3 specimens) taken in 1600-1700 m off the northwest coast of Australia and two specimens recorded by IWAMOTO & WILLIAMS (1999) from the same region in 1460-1500 m. The current specimen extends the range into the southwestern Pacific.

REMARKS. — The HALIPRO 2 specimen is only the sixth known of the species. More trawling at depths greater than 1500 m along the continental slopes of Australia, New Caledonia, and Indonesia may capture additional specimens that would help in understanding the distribution and biology of the fish.

Genus ***CETONURUS*** Günther, 1878

Head large, globose, broad and deep, interorbital space 37-53% HL, suborbital deep, 22-31% HL. Mouth inferior, 25-38% HL; chin barbel small. Head fully scaled, including lowermost rays of branchiostegals and often over gular membrane; scales along anterior portion of second dorsal fin enlarged, with larger, coarser spinules. Course of lateral line usually marked by free neuromasts, generally lacking grooved scales. Pelvic fin with 8-13 rays, origin usually slightly anterior to origin of first dorsal and pectoral fins. Periproct broad, immediately anterior to anal fin; anus in middle of periproct and thus removed slightly from anal fin. (Characters mostly from SAZONOV & SHCHERBACHEV, 1985.) Two species. Circumglobal in middle to low latitudes, but absent along Pacific coast of the Americas.

Cetonurus crassiceps (Günther, 1878)

Fig. 16

Coryphaenoides crassiceps Günther, 1878: 25 (n. of Kermadec I., *Challenger* Stn 170, 520 fathoms and Stn 171, 600 fathoms).
Macrurus (Cetonurus) crassiceps - GÜNTHER, 1887: 143.
Cetonurus crassiceps - PAULIN *et al.*, 1989: 129 (in key). — GRANDPERRIN *et al.*, 1997: 117 (New Caledonia; list).

MATERIAL EXAMINED. — 17 specimens.

Vanuatu. MUSORSTOM 8: stn CP 1125, 15°57.63'S, 166°38.43'E, 1160-1220 m, 10.10.1994: 1 male specimen 74.6 mm HL, 381+ mm TL (MNHN 1995-900).

Loyalty Ridge. HALIPRO 2: stn BT 12, 24°21.02'S, 170°01.02'E, 1140-1188 m, 8.11.1996: 2 specimens 69-82 mm HL 335+-355+ mm TL (MNHN 1998-243), 1 specimen (CAS 90602), 1 specimen (CAS 90694), 1 specimen (NMNZ P.34273). — Stn BT 16, 24°33.85'S, 170°06.47'E, 1019-1200 m, 8.11.1996: 1 specimen 100 mm HL, 405+ mm TL (MNHN 1998-244).

Norfolk Ridge. HALIPRO 2: stn BT 32, 25°19'S, 168°56'W, 697-1340 m, 12.11.1996: 1 specimen 51 mm HL, 275+ mm TL (CAS 90744), 1 specimen (MNHM 1998-252), 1 specimen (MNHN 1998-253), 2 specimens (NMNZ

Source : MNHN, Paris

P.34270). — Stn BT 44, 25°43'S, 167°12'W, 1033-1200 m, 15.11.1996: 2 specimens 79-82 mm HL, 320+-350+ mm TL (CAS 90603). — Stn BT 95, 23°56.86'S, 162°07.57'E, 1224-1233 m, 25.11.1996: 1 specimen (MNHN 1998-255).

Lord Howe Rise. HALIPRO 2: stn BT 104, 25°23'S, 162°5'W, 1118-1124 m, 27.11.1996: 2 specimens 44-48.6 mm HL, 190+-237+ mm TL (CAS 90673).

DIAGNOSIS. — Scales on gular and branchiostegal membranes few, isolated; orbit 17-23% HL; scales below 1D. 11-14 (usually 12-13), below 2D. 9-13 (usually 10-11).

DESCRIPTION. — *Counts*: 1D. II,8-10; P. i15-i18; V. 10-11; GR-I (inner series) 2+11. *Measurements* (in percent HL): snout 36-38; preoral 31-37; orb. 18-26; suborb. 23-28; interorb. 43-48; postorb. 45-51; orb.-preop. 45-51; up.jaw 30-33.

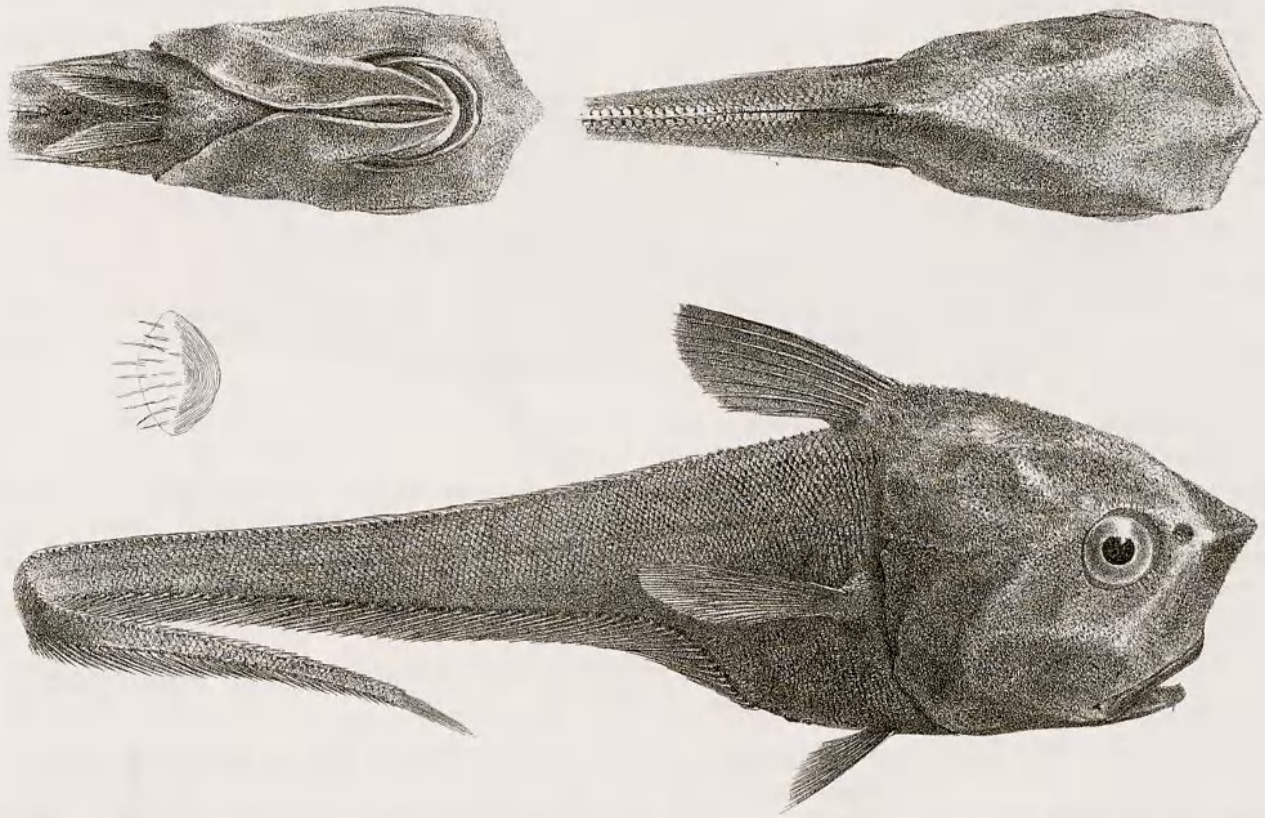

FIG. 16. — *Cetonurus crassiceps* (Günther, 1878). A 13 inch [about 32.5 cm] specimen taken north of the Kermadec Islands, *H.M.S. Challenger*, stn 170, in 520 fm [951 m]. From GÜNTHER, 1887, pl. XXXVII.

REMARKS. — *Cetonurus crassiceps* was taken in considerable numbers in several trawls during the HALIPRO 2 cruise. Again, the large trawl used during that cruise probably accounted for the high numbers taken, as opposed to none on cruises previous to MUSORSTOM 8 and HALIPRO 2.

On casual observation, this species can be easily mistaken for *Squalogadus modificatus*, with which it is sometimes taken, owing to the similarity of their large, globose heads. *C. crassiceps* can be immediately distinguished by its high, short, first dorsal fin followed by a long, low second dorsal. *Squalogadus*, in contrast, has only one long, low dorsal fin. SAZONOV & SHCHERBACHEV (1985) recorded *Cetonurus globiceps*, the second member of the genus, from New Zealand, but we found no specimen corresponding to that species in our New Caledonia collections. The two authors provided data in confirmation of the differences between the two species. Our specimens agree well with their description of *C. crassiceps*, especially in terms of the smaller orbit; rougher, somewhat larger scales; smaller, more-rudimentary chin barbel; naked margin along the anal fin; and general head shape. We found that scale-row counts below the first dorsal fin were too difficult to make to be useful for us.

Source : MNHN, Paris

Also, the distribution of teeth in the jaws, which they considered distinguishing, did not appear to be so with our New Caledonian specimens and three *C. globiceps* from Walters Shoals in the southwestern Indian Ocean (CAS 66484).

Genus ***CORYPHAENOIDES*** Gunner, 1765

Coryphaenoides dossenus McMillan, 1999

Fig. 17

Coryphaenoides (Coryphaenoides) sp. indet. - IWAMOTO, 1986: 355 (Mozambique, 696-960 m).
Coryphaenoides (Coryphaenoides) rudis - McCANN & McKNIGHT, 1980: 35, Figs 16-18 (in part; New Zealand).
Coryphaenoides sp. B - PAULIN *et al.*, 1989: 129, Fig. 56.30b (in key to New Zealand fishes). — GRANDPERRIN *et al.*, 1997: 117 (New Caledonia; list).
Coryphaenoides sp. - OKAMURA *in* AMAOKA *et al.*, 1990: 184, Fig. 126 (New Zealand, 100-763 m). — GOMON *et al.*, 1994: 355, Fig. 315 (Australia).
Coryphaenoides sp. 1 - SHCHERBACHEV & IWAMOTO, 1995: 309-312, Fig. 8 (synonymy; distr., 696-1600 m).
Coryphaenoides dossenus McMillan, 1999: 482-486, Figs 1-2.

MATERIAL EXAMINED. — 3 specimens.
Vanuatu. MUSORSTOM 8: stn CP 1129, 16°00.73'S, 166°39.94'E, 1014-1050 m, 10.10.1995: 1 specimen 50 mm HL (MNHN 1995-986).
Norfolk Ridge. HALIPRO 2: stn BT 38, 24°55.69'S, 168°19.9'E, 856-1450 m, 13.11.1996: 1 specimen (NMNZ uncat.). — Stn BT 85, 23°40.02'S, 168°03.15'E, 935-1100 m, 23.11.1996: 1 specimen 156 mm HL female (BMNH 1997.5.21:54).

DIAGNOSIS. — Head profile low, followed by highly arched nape in adults; pelvic fin rays 8, rarely 9; snout low, rounded, barely protruding in adults, preoral length 7-11% HL; upper jaw long, 40-45% HL, extending well past vertical through hind end of orbit; barbel long, 21-34% HL; inner gill rakers of first arch 11-13 total; premaxillary teeth in broad band, mandibular teeth in several rows; body scales covered with small, closely packed spinules in parallel to slightly convergent rows.

SIZE. — To at least 85 cm TL.

DISTRIBUTION. — From the southeastern Atlantic to southern Africa, Indian Ocean, Australia, New Zealand, and the New Caledonian region. Depth range about 700-1600 m.

REMARKS. — This species attains large adult size. It is quite abundant off the New South Wales coast of Australia, and extensive collections are housed in the Australian Museum in Sydney. It has already been well described numerous times (e.g., GOMON *et al.*, 1994; SHCHERBACHEV & IWAMOTO, 1995) and well illustrated (including color photographs), but it awaited a scientific name by Peter McMILLAN. Only a single juvenile was collected off Vanuatu, but two large adults were captured off the Norfolk Ridge during HALIPRO 2.

Coryphaenoides rudis Günther, 1878

Fig. 18

Coryphaenoides rudis Günther, 1878: 24 (Kermadec Islands). — SHCHERBACHEV & IWAMOTO, 1995: 301-302 (Indian Ocean). — GRANDPERRIN *et al.*, 1997: 117 (New Caledonia, list).
Macrurus (Macrurus) rudis - GÜNTHER, 1887: 131, pl. 27.
Nematonurus macrocephalus Maul, 1951: 17 (Madeira).
Macrourus paradoxus Smith & Radcliffe *in* RADCLIFFE, 1912: 115-116, pl. 25, Fig. 1 (eastern Palawan, Philippines). — IWAMOTO & SAZONOV, 1988: 52-53 (se. Pacific).

MATERIAL EXAMINED. — 3 specimens.
Lord Howe Rise. HALIPRO 2: stn BT 106, 25°29.08'S, 163°13.116'E, 1315-1357 m, 27.11.1996: 1 specimen (MNHN uncat.).

Source : MNHN, Paris

Norfolk Ridge. HALIPRO 2: stn BT 77, 24°11.38'S, 167°45.52'E, 1349-1350 m, 21.11.1996: 1 specimen 175 mm HL, 785+ mm TL (MNHN 1998-317). — Stn BT 82, 23°51.5'S, 168°25.98'E, 1846-1862 m, 22.11.1996: 1 specimen 257 mm HL, 1180 mm TL (NMNZ P.34027).

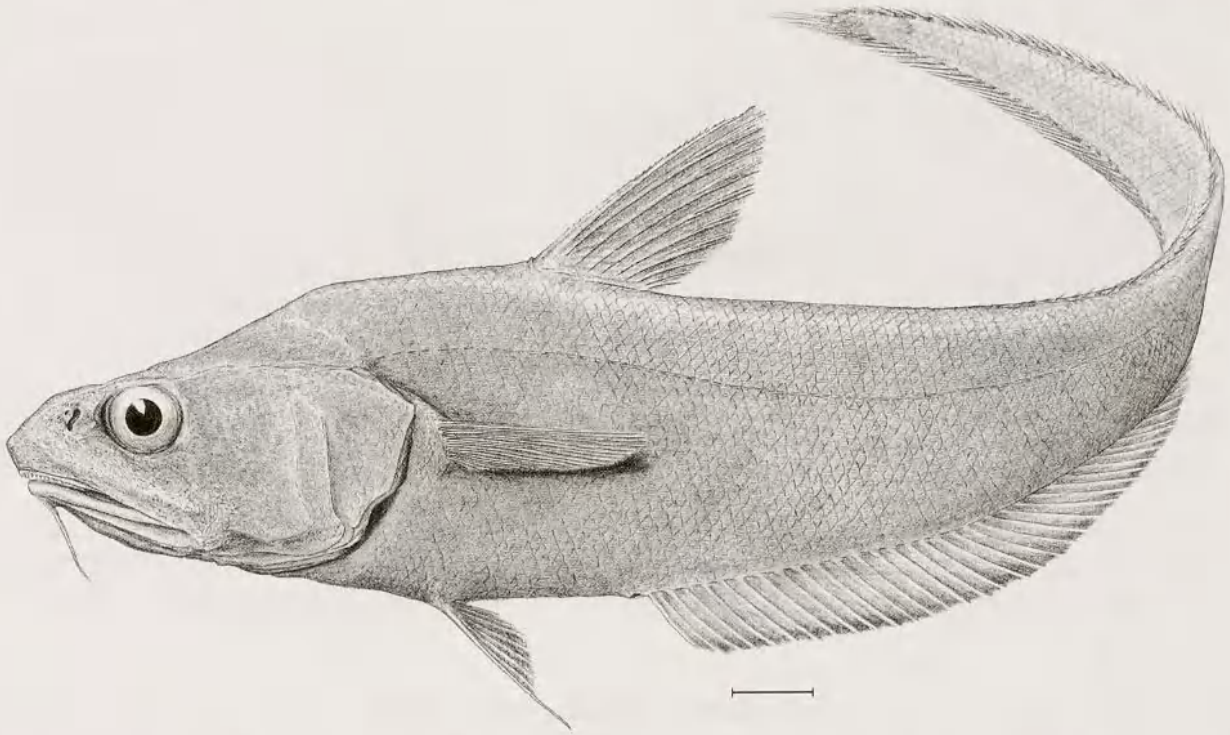

FIG. 17. — *Coryphaenoides dossenus* McMillan, 1999. Paratype (CAS 71488, 57 cm TL) from east of New Zealand in 1200 m depth. Fins and scales partially reconstructed. Scale = 25 mm. From SHCHERBACHEV & IWAMOTO, 1995, fig. 8. Used with permission of the California Academy of Sciences.

DIAGNOSIS. — Pelvic fins with 9 or 10 rays (rarely 8 or 11); snout low, scarcely protruding; orbits small, about 1.5 into snout, 1.8-1.9 into interorbital width, 5-6 into HL; upper jaw extends beyond vertical through hind margin of orbits; premaxillary teeth in narrow band flanked by enlarged outer series, mandibular series 2-3 teeth wide narrowing to one irregular row; outer gill slit small, 4-9% HL; inner gill rakers on first arch about 10 total; barbel 10-23% HL; underside of head fully scaled.

DESCRIPTION (of MNHN uncat., HALIPRO 2 Stn BT 82). — *Counts*: 1D. II,10; P. i21; V. 11; GR-I (inner) 1+1+7, GR-II (outer/inner) 2+6 / 1+1+7; scales below 1D. about 10, below mid-1D. 7.5, below 2D. 6.5, lat.line 39 over distance equal to predorsal length.

Measurements: 257 mm HL, 118 mm TL. The following in percent HL: snout 29; preoral 11; internasal 20; interorb. 32; orb. 18; suborb. 14; postorb. 58; orb.-preop. 54; up.jaw 42; barbel 17; depth 109; ht. 1D. 52; len. V. 38.

SIZE. — To more than 120 cm TL.

DISTRIBUTION. — Widespread in tropical to subtropical waters of the Pacific, Indian, and Atlantic oceans. Depth range about 980-2380 m.

REMARKS. — *Coryphaenoides rudis* has already been well described and illustrated in previous publications (see synonymy). Our three large specimens taken during HALIPRO 2 agree well with these descriptions. MNHN uncat. is a female with large ovaries, but small eggs.

Source : MNHN, Paris

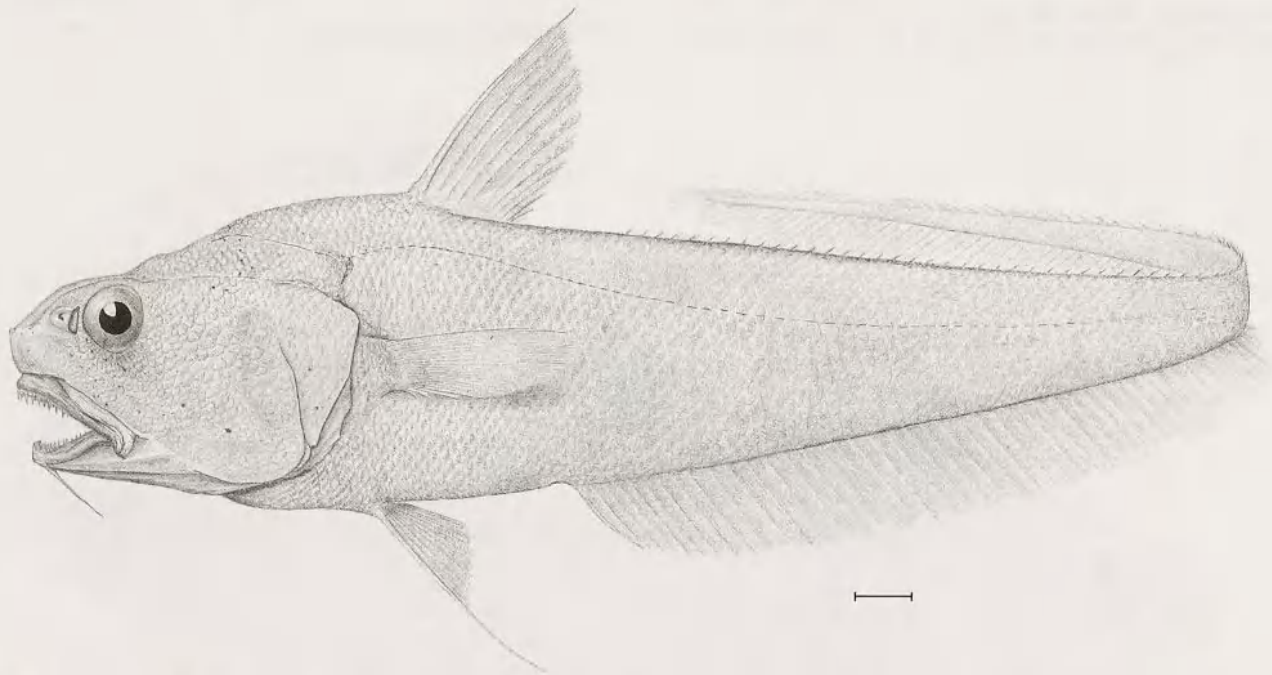

FIG. 18. — *Coryphaenoides rudis* Günther, 1878. MMSU P-16528 (155 mm HL) from Nazca Ridge in 980 m. Scale = 25 mm. From IWAMOTO & SAZONOV, 1988, fig. 28. Used with permission of the California Academy of Sciences.

Coryphaenoides striaturus Barnard, 1925

Coryphaenoides striaturus - IWAMOTO & MERRETT, 1997: 511-512, Fig. 17 (New Caledonia). — GRANDPERRIN *et al.*, 1997: 117 (New Caledonia; list).

MATERIAL EXAMINED. — 2 specimens.

Norfolk Ridge. HALIPRO 2: stn BT 74, 24°44.9'S, 167°43.1'E, 1213-1246 m, 20.11.1996: 1 specimen 80 mm HL, 406 mm TL (CAS 90840). — Stn BT 77, 24°11.38'S, 167°45.52'E, 1349-1350 m, 21.11.1996: 1 specimen (NMNZ P.34252).

REMARKS. — A widespread species known from the southeastern Atlantic, Indian Ocean, southern Australia, New Zealand, and New Caledonia.

Genus *HAPLOMACROURUS* Trunov, 1980

Haplomacrourus nudirostris Trunov, 1980

Haplomacrourus nudirostris - IWAMOTO & MERRETT, 1997: 513-514, Fig. 18 (Wallis & Futuna Islands).

MATERIAL EXAMINED. — 2 specimens.

Vanuatu. MUSORSTOM 8: stn CP 990, 18°51.63'S, 168°50.98'E, 980-990 m, 24.09.1994: 1 specimen 20 mm HL, 91+ mm TL (MNHN 1995-998). — Stn CP 1129, 16°00.73'S, 166°39.94'E, 1014-1050 m, 10.10.1994: 1 specimen 23.6 mm HL, 37+ mm TL (MNHN 1995-987).

REMARKS. — A single juvenile from the Wallis and Futuna Islands was recorded by IWAMOTO & MERRETT (1997: 513). The Vanuatu collections had two additional juveniles; no specimens were collected during the HALIPRO 2 cruise.

Source : MNHN, Paris

Genus *HYMENOCEPHALUS* Giglioli, 1884

Hymenocephalus adelscotti Iwamoto & Merrett, 1997

Hymenocephalus adelscotti - IWAMOTO & WILLIAMS, 1999: 176, Fig. 31a (Western Australia off Shark Bay, 680-691 m).

This species was not represented in recent MUSORSTOM collections, but one specimen was recently recorded from the eastern Indian Ocean by IWAMOTO & WILLIAMS (1999). The two peculiarly disjunct records (Fiji and Western Australia) may be indicative of a much broader range for the species.

Hymenocephalus aterrimus Gilbert, 1905

Hymenocephalus aterrimus - IWAMOTO & MERRETT, 1997: 516-517, Fig. 20a (New Caledonia, Norfolk Ridge, Wallis & Futuna Islands).
Hymenocephalus (Papyrocephalus) aterrimus - GRANDPERRIN *et al.*, 1997: 117 (New Caledonia; list).

MATERIAL EXAMINED. — 5 specimens.
Vanuatu. MUSORSTOM 8: stn CP 990, 18°51.63'S, 168°50.98'E, 980-990 m, 24.09.1994: 1 specimen (MNHN 1995-999). — Stn CP 1125, 18°52.41'S, 168°55.73'E, 764-786 m, 10.10.1994: 1 specimen (MNHN 1997-673).
Norfolk Ridge. HALIPRO 2: stn BT 76, 24°05.43'S, 167°34.29'E, 936-940 m, 21.11.1996: 2 specimens 15-38 mm HL, 59-128+ mm TL (CAS 90611).
Loyalty Ridge. HALIPRO 2: stn BT 25, 25°16.64'S, 170°23.69'E, 1100-1348 m, 11.11.1996: 1 specimen 32 mm HL, 140+ mm TL (MNHN 1998-315).

REMARKS. — The species is broadly distributed, but is rarely caught in the area.

Hymenocephalus gracilis Gilbert & Hubbs, 1920

No specimens of this species were collected during recent cruises.

Hymenocephalus kuronumai Kamohara, 1938

No specimens of this species were collected during recent cruises.

Hymenocephalus longibarbis (Günther, 1887)

Hymenocephalus longibarbis - IWAMOTO & MERRETT, 1997: 520-521, Fig. 21b (New Caledonia, Norfolk Ridge). — GRANDPERRIN *et al.*, 1997: 117 (New Caledonia; list).

MATERIAL EXAMINED. — 20 specimens.
Vanuatu. MUSORSTOM 8: stn CP 1033, 17°54.75'S, 168°40.66'E, 650-691 m, 29.09.1994: 2 specimens (MNHN 1995-956). — Stn CP 1050, 16°39.20'S, 168°01.30'E, 541-577 m, 1.10.1994: 1 specimen (MNHN 1995-860). — Stn CP 1052, 16°32.37'S, 168°00.29'E, 561-564 m, 1.10.1993: 1 specimen (MNHN 1995-957). — Stn CP 1073 15°45.70'S, 167°22.24'E, 630-650 m, 4.10.1994: 1 specimen (MNHN 1997-694). — Stn CP 1114, 14°52.39'S, 167°03.40'E, 647 m, 8.10.1994: 2 specimens (MNHN 1997-671).
New Caledonia. BATHUS 1: stn CP 657, 21°14.45'S, 165°54.93'E, 490-530 m: 4 specimens (MNHN 1995-816). — Stn CP 658, 21°13.45'S, 165°55.12'E, 515-580 m, 12.03.1993: 2 specimens (MNHN 1995-826). — Stn CP 708, 21°43.05'S, 166°38.57'E, 550-580 m, 19.03.1993: 3 specimens (MNHN 1995-813). — Stn CP 709, 20°57.54'S, 165°35.86'E, 302-335 m, 18.03.1993: 4 specimens (MNHN 1997-687).

REMARKS. — This species was not taken during the HALIPRO 2 cruise, possibly indicating a distribution concentrated to the north of the area fished. It is also possible that individuals were able to pass through the mesh of the larger nets used during that cruise.

Source : MNHN, Paris

Hymenocephalus megalops Iwamoto & Merrett, 1997

Fig. 19

Hymenocephalus megalops Iwamoto & Merrett, 1997: 521-523, Fig. 22a (New Caledonia, Chesterfield & Bellona Plateau, Norfolk Ridge, Wallis & Futuna Islands, Australia).

MATERIAL EXAMINED. — 183 specimens.

Vanuatu. MUSORSTOM 8: stn CP 980, 19°21.02'S, 169°25.22'E, 450-433 m, 22.09.1994: 2 specimens (MNHN 1995-993). — Stn CP 994, 18°47.72'S, 168°56.17'E, 649-641 m, 24.09.1994: 31 specimens (MNHN 1997-707). — Stn CP 1007, 18°51.97'S, 168°55.92'E, 720-830 m, 25.09.1994: 1 specimen (MNHN 1997-705). — Stn CP 1028, 17°54.01'S, 168°40.42'E, 624-668 m, 28.09.1994: 9 specimens (MNHN 1995-962). — Stn CP 1033, 17°54.75'S, 168°40.66'E, 650-691 m, 29.09.1994: 1 specimen (MNHN 1997-708). — Stn CP 1034, 17°54.85'S, 168°42.04'E, 690-750 m, 29.09.1994: 1 specimen (MNHN 1995-974). — Stn CP 1050, 16°39.20'S, 168°01.30'E, 541-577 m, 1.10.1994: 95 specimens (MNHN 1995-853). — Stn CP 1052,16°32.37'S, 168°00.29'E, 561-564 m, 1.10.1993: 20 specimens (MNHN 1995-95). — Stn CP 1053, 16°29.3'S, 167°58.70'E, 536-519 m, 1.10.1994: 7 specimens (MNHN 1997-706). — Stn CP 1054, 16°27.95'S, 167°57.44'E, 522-527 m: 2 specimens (MNHN 1995-984). — Stn CC 1056, 16°33.11'S, 167°55.64'E, 602-620 m: 5 specimens (MNHN 1995-989). — Stn CP 1073, 15°45.70'S, 167°22.24'E, 630-650 m, 4.10.1994: 2 specimens (MNHN 1997-705). — Stn CP 1114, 14°52.39'S, 167°03.40'E, 647 m, 8.10.1994: 3 specimens (MNHN 1997-672).

New Caledonia. BATHUS 1: stn CP 709, 20°57.54'S, 165°35.86'E, 302-335 m, 18.03.1993: 4 specimens (MNHN 1995-812).

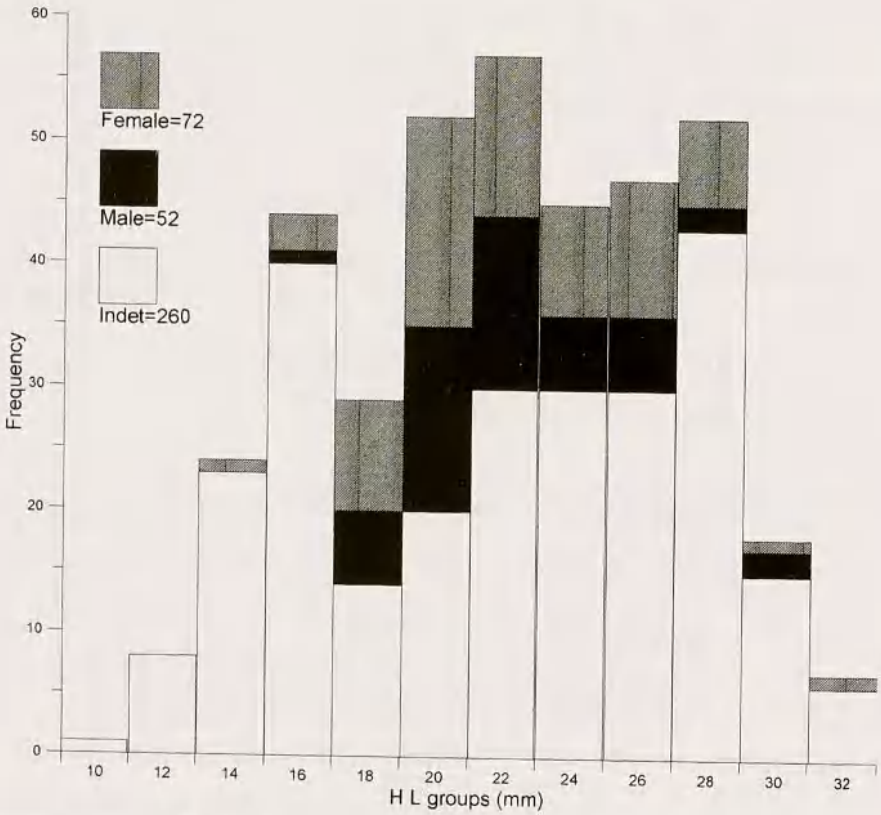

FIG. 19. — Length-frequency (HL, head length mm) distribution of *Hymenocephalus megalops* by sex (n = 384).

REMARKS. — This was the most abundant species of grenadier in our samples, both in number of individuals and in number of captures. That none were taken during HALIPRO 2 is probably accounted for by its having a distribution to the north of the sampling area. As with other species of small size, the larger mesh size in the trawl used during that cruise may also have been a factor in its absence in the catches. It evidently attains sexual

Source : MNHN, Paris

maturity in the range 13-22 mm HL (Table 5). One large sample contributed most to the length-frequency analysis, but the overall indication is that the population peaks broadly over the range 20-26 mm HL classes (Fig. 19). In common with many of the species encountered in these collections, the males of *H. megalops* are macrosmatic and the females have ovaries containing several generations of ripening ova. Such features of presumed mate location and reproductive style are well known and are commented on elsewhere (MERRETT, 1994). The only stomach examined contained digested crustacean remains and lacked sediment, to indicate pelagic rather than benthic feeding.

Hymenocephalus nascens Gilbert & Hubbs, 1920

Fig. 20

Hymenocephalus nascens - IWAMOTO & MERRETT, 1997: 523-525 (New Caledonia, Norfolk Ridge, Chesterfield & Bellona Plateau, Wallis & Futuna Islands).

MATERIAL EXAMINED. — 147 specimens.

Vanuatu. MUSORSTOM 8: stn CP 992, 18°52.34'S, 168°55.16'E, 775-748 m, 24.09.1994: 11 specimens (MNHN 1995-866). — Stn CP 993, 18°48.78'S, 168°54.04'E, 780-783 m, 24.09.1994: 34 specimens (MNHN 1995-969). — Stn CP 994, 18°47.72'S, 168°56.17'E, 649-641 m, 24.09.1994: 20 specimens (MNHN 1995-873). — Stn CC 996, 18°52.41'S, 168°55.73'E, 764-786 m, 24.09.1994: 61 specimens (MNHN 1995-839). — Stn CP 1007, 18°51.97'S, 168°55.92'E, 720-830 m, 25.09.1994: 7 specimens (MNHN 1997-709). — Stn CP 1028, 17°54.01'S, 168°40.42'E, 624-668 m, 28.09.1994: 1 specimen (MNHN 1997-711). — Stn CP 1033, 17°54.75'S, 168°40.66'E, 650-691 m, 29.09.1994: 5 specimens (MNHN 1997-710). — Stn CP 1034, 17°54.85'S, 168°42.04'E, 690-750 m, 29.09.1994: 1 specimen (MNHN 1997-712). — Stn CP 1073, 15°45.70'S, 167°22.24'E, 630-650 m, 4.10.1994: 2 specimens (MNHN 1995-851).

New Caledonia. BATHUS 1: stn CP 660, 21°10.48'S, 165°53.19'E, 786-800 m, 13.03.1993: 2 specimens (MNHN 1995-823). — Stn CP 663, 20 58.66'S, 165 38.27'E, 755 m, 13.03.1993: 1 specimen (MNHN 1995-824). — Stn CP 709, 20°57.54'S, 165°35.86'E, 302-335 m, 18.03.1993: 2 specimens (MNHN 1997-703).

REMARKS. — *Hymenocephalus nascens* was another relatively abundant species in the catches, although it was not taken during the HALIPRO 2 cruise. The majority of the population sampled were in the head length range 16-28 mm of a unimodal catch distribution (Fig. 20a). Ovarian maturity was evidently attained at least by the 16 mm HL class and breeding had occurred in some females in the 24 mm HL class, which were already spent (Fig. 20b). More than one generation of ova were present in the ovaries, suggesting a likely batch-spawning strategy. Males were found to be macrosmatic. Four out of the five stomachs in which contents were found contained digested crustacea and no sediment. Identification of material in one of these suggested that the prey was either a decapod or a euphausiid.

Hymenocephalus nesaeae sp. nov.

Fig. 21

MATERIAL EXAMINED. — 3 specimens.

Vanuatu. MUSORSTOM 8: stn CP 1008, 18°53.29'S, 169°52.65'E, 919-1000 m, 25.09.1994: holotype 30.7 mm HL, 143+ mm TL (MNHN 1995-869). — Stn CP 990, 18°51.63'S, 168°50.98'E, 980-990 m, 24.09.1994: 1 paratype 28.6 mm HL, 130 mm TL (MNHN 1995-999). — Stn CP 1125, 18°52.41'S, 168°55.73'E, 764-786 m, 10.10.1994: 1 paratype 19.9 mm HL, 97 mm TL (MNHN 1997-673).

DIAGNOSIS. — Pelvic fin rays 13-14; barbel absent; orbits 4-5 in head length, 1.2-1.6 into interorbital width; suborbital width 1.3-1.7 into orbit; orbit-to-preopercle distance 42-50% HL; upper jaw 55-58% HL; body color brown, scale pockets prominent, no trace of silvery pigmentation.

DESCRIPTION. — *Counts*: 1D. II9-10; P. i13-i15; V. 13-14; GR-I (outer/inner) 19-21 / 5+20-21, GR-II (4-5)+(20-21) / (4-5)+(19-21); scales over distance equal to predorsal length 18-19; pyloric caeca about 8 (1 spec.).

Measurements (in percent of HL): snout 27-33; preoral 13-14; internasal 24-26; interorb. 31-34; orb. 22-26.

Source : MNHN, Paris

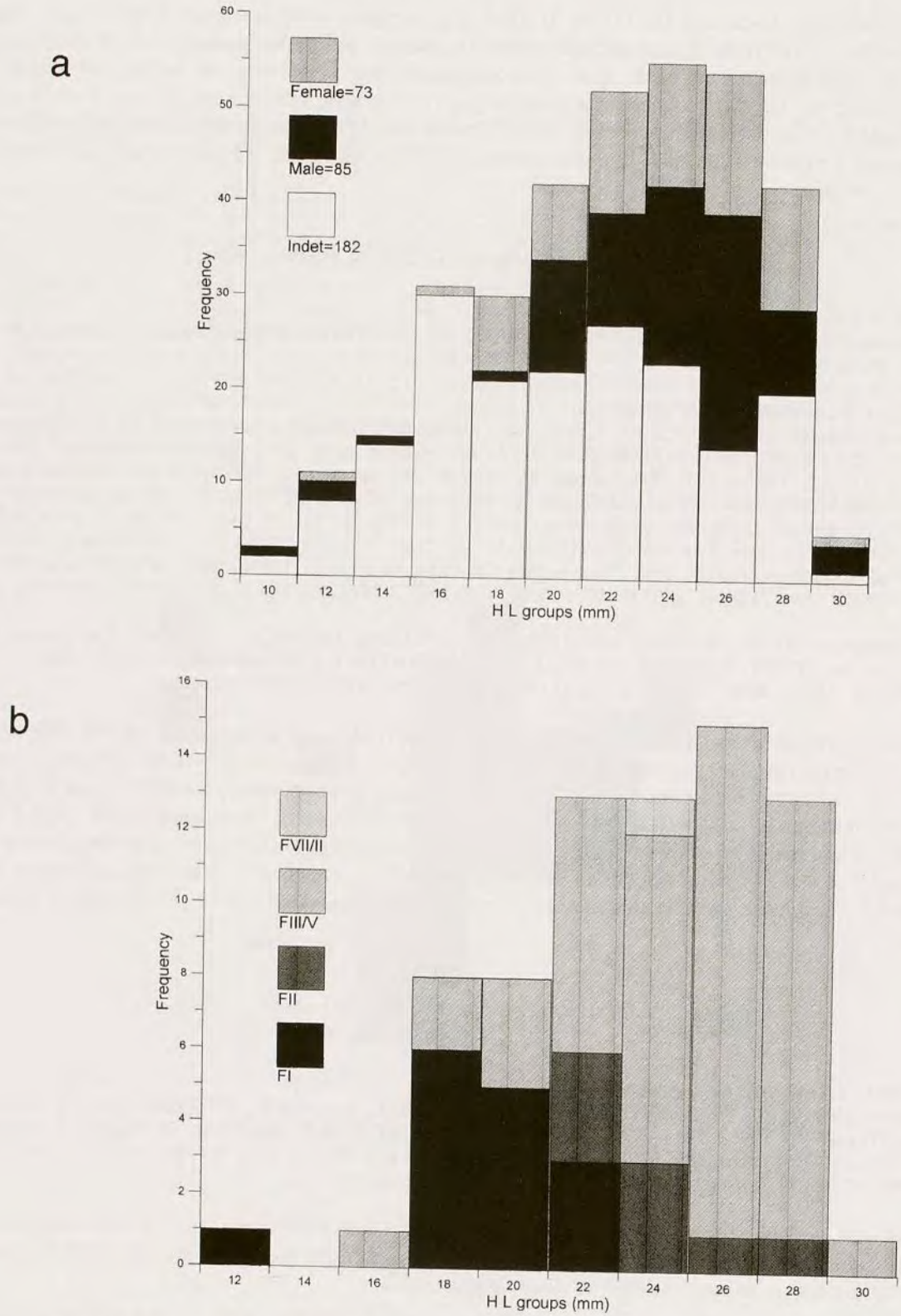

FIG. 20. — Length-frequency (HL, head length mm) distribution of *Hymenocephalus nascens*: (**a**) by sex (n = 340); (**b**) by ovarian maturity stage (n = 73). FI = immature; FII = yolk and chorion formation; FIII/V = egg maturation; FVII/II = recovering spent.

Source : MNHN, Paris

Head moderately broad, greatest width about 1.2 into greatest body depth; snout slightly protruding, lacking a thin flexible nasal flap. Mouth large, upper jaw extending well beyond vertical of posterior edge of orbit. Suborbital region vertical except for narrow, tapered dorsal shelf. Head covering transparent except over opercular region.

Luminescent tissue (ventral striae) relatively limited and not prominent; extending posteriorly as a narrow band along both sides of isthmus below gill covers, passing dorsal to pelvic fin base, expanding medially and posteriorly behind pelvic bases but not joining along median line and falling well short of periproct region; anterior lens on chest small, scarcely discernible without magnification; posterior lens before periproct considerably larger.

Fin rays all fine and slender, none thick and well-developed; outer ray of pelvic fins prolonged, extending well beyond anal fin origin, about to base of eighth ray; spinous dorsal ray slightly produced, hairfine at distal tip.

Body color uniformly dark brown with large scale pockets prominently marked. No trace of lateral band nor suggestion of there having been any silvery tissue. Dark pigmentation uniformly covers all of trunk and tail, with abdomen and chest forward to isthmus black. Most of opercular bones and inner wall of suborbital bones black; lips, jaws, gular and branchiostegal membranes black; most of roof of mouth black, but tongue pale. Dorsal fin dark dusky; most of pectoral, pelvic and anal fins dark dusky. Leading edge and median nasal ridge of snout, and interorbital space at top of orbits black.

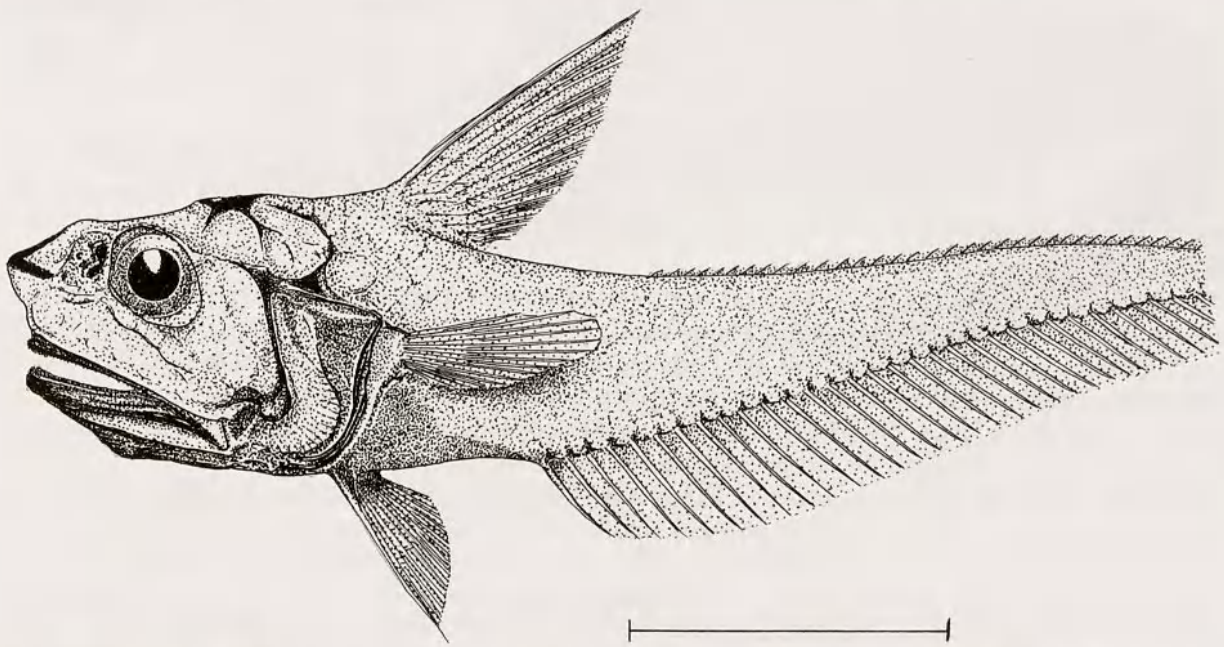

FIG. 21. — *Hymenocephalus nesaeae* sp. nov. Lateral view of head and trunk of holotype (MNHN 1995-869), with fins partially reconstructed. Scale = 25 mm.

SIZE. — To more than 140 mm TL.

ETYMOLOGY. — From the Greek, *Nesaie*, one of the Nereids, a sea nymph.

DISTRIBUTION. — So far known only from three hauls made off Vanuatu in depths between 764 m and 1000 m.

REMARKS. — *Hymenocephalus nesaeae* has the characters of high pelvic ray count, absence of a chin barbel, and uniformly dark body color that are similarly found in *H. aterrimus*, but *H. aterrimus* has a much smaller orbit, broader head, deeper suborbital, a thin anterodorsally pointed snout tip, and a more uniformly black head. *H. nascens* has similar pelvic ray counts and no barbel, but the body in that species has a prominent broad lateral stripe over a lighter ground.

Source : MNHN, Paris

The presence of another species of *Hymenocephalus* in waters in and around the New Caledonian region brings the total known from MUSORSTOM collections to eight, making it comparable to the Philippines-Indonesian region in terms of the diversity of the genus.

Genus ***KUMBA*** Marshall, 1973

Kumba musorstom sp. nov.

Fig. 22

Kumba punctulata (*non* Iwamoto & Sazonov) - GRANDPERRIN *et al.*, 1997: 117 (New Caledonia; listed).

MATERIAL EXAMINED. — 1 specimen.

Norfolk Ridge. HALIPRO 2: stn BT 55, 25°02.85'S, 168°45.42'E, 1098-1480 m, 17.11.1996: holotype, female, 72.6 mm HL, 425 mm TL (MNHN 1998-232).

DIAGNOSIS. — Pelvic fin rays 12-13, outer ray large, greatly elongated; spinous second ray of first dorsal fin elongated and with few tiny denticulations along leading edge; naked areas on snout extend dorsally beyond lateral nasal angles; snout length greater than interorbital width; upper jaw length about half head length; barbel about 17% HL; no external sign of light organ.

DESCRIPTION OF HOLOTYPE. — *Counts:* 1D. II,10; P. i22/i21; GR-I (outer/inner) 9/3+11, GR-II 3+11 / 3+10; scales below 1D. 9, below mid-base 1D. 7, below 2D. 10.5, lat. line 37.

Measurements (in mm, percent HL in parentheses): snout 19.7 (27); preoral 12.9 (18); internasal 11.4 (16); interorb. 14.9 (21); orb. 15.0 (21); suborb. 11.4 (16); postorb. 41.3 (57); orb.-preop. 33.8 (47); up.jaw 35.3 (49); barbel 12.0 (17); gill-slit 14 (19); pre-A. 108 (149); V.-A. 32 (44); depth 63 (87); 1D.-2D. 10.5 (14); ht. 1D. 63 (87); len. P. 43 (59); len. V. 126 (174).

General features of fish seen in Fig. 22. Head relatively compressed, deeper than wide, greatest width about 1.2 into greatest head depth, head length almost 6 times into total length. Snout rounded in profile, protruding slightly beyond mouth. Interorbital region incised anteriorly by two grooves on either side of median nasal ridge, and posteriorly by a shallow median depression anterior to origin of nape. Suborbital region almost vertical, with little development of a ridge. Mouth large, lips thick, upper jaw extends slightly beyond vertical through hind margin of orbit. Chin barbel slender, length about equal to horizontal diameter of orbit.

Underside of head almost entirely naked, including snout, suborbital, ventral margins of preopercle and most of interopercle (excepting small scale patch at posterior end), and lower jaw. Areas under snout, suborbital and lower jaw peppered with small open pores. Dorsal surface of snout naked to level of anterior nostril, thence posteriorly in two thin strips at bottom of grooves running on either side of median nasal ridge. Ridges surrounding nasal fossa scaled, as well as upper portion of suborbital. Anus immediately before anal fin; periproct small, about equal in area to nasal fossa. No external evidence of light organ. Holotype a female with large ovaries; small eggs developed.

Dorsal fin with a greatly elongated spinous ray extending as a thin filament well beyond adjacent rays; leading edge of prolonged ray smooth except for two tiny teeth about midway along length. Second dorsal fin low throughout, begins close behind first dorsal, the interspace between fins about half length of base of first dorsal. Pectoral fin well developed, the longest rays extending to over 8-10th anal rays. Pelvic fin small except for stout, greatly prolonged outer ray, which is longer than preanal distance and filamentous at distal tip. First dorsal origin posterior to that of pectoral origin, which is posterior to that of pelvic origin. Anal fin begins approximately under posterior 1/4th of first dorsal base.

Small teeth in upper jaw in long broad band, outer series of slightly enlarged spaced conical teeth. Lower jaw teeth in narrow band about three teeth across.

Scales of body almost entirely lost, a few scales along anterior origin of lateral line and over nape. These with characteristic (for genus) narrow, comblike rows of slender spinules. Rows somewhat divergent. Head scales all small, and characteristic of genus (comblike divergent rows of spinules).

Source : MNHN, Paris

Overall color of body and tail brownish with bluish tinge over abdomen and chest. Head generally paler, ventral surfaces white overlain with smudgelike marks. Lips blackish along mouth opening but jaw surfaces otherwise almost immaculate. Mouth whitish on roof, darker over other surfaces, blackish over oral valves and gums. Gill cavity black; gill arches and rakers dark. Branchiostegal membrane black but pale over rays. Opercle and subopercle blackish; most of other parts of head surfaces gray to whitish. Area around orbit and nostrils brownish. Fins all brownish to gray-brown.

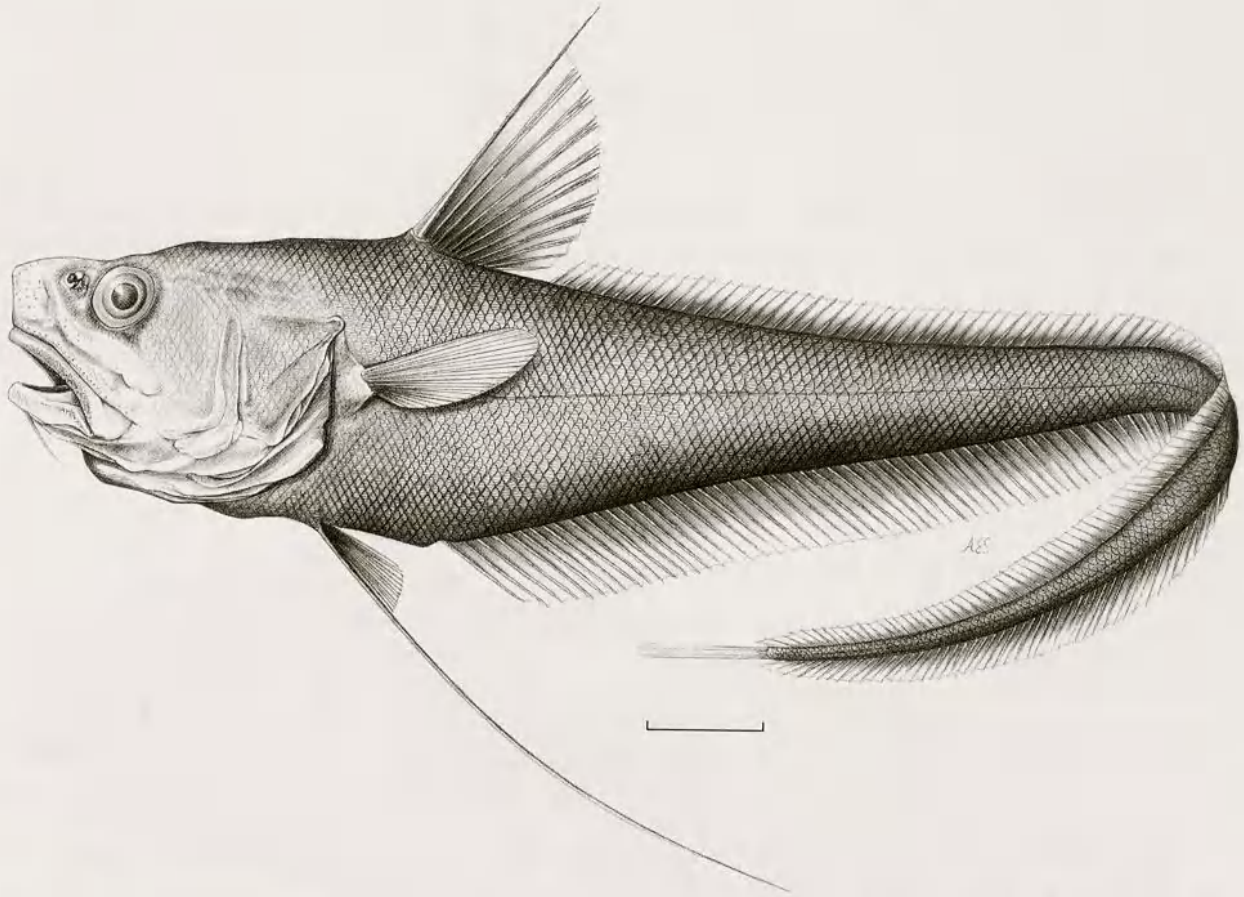

FIG. 22. — *Kumba musorstom* sp. nov. Lateral view of holotype (MNHN 1998-232) from Norfolk Ridge in 1098-1480 m depth. Scale = 25 mm. Drawn by Alison SCHROEER.

SIZE. — To at least 43 cm TL.

ETYMOLOGY. — The name derives from the acronym, MUSORSTOM, for the series of exploratory cruises carried out in the Indo-West Pacific region jointly by the Institut français de Recherche Scientifique pour le Développement en Coopération (ORSTOM – now IRD) and the Muséum national d'Histoire naturelle (MNHN). The name is treated as a noun in apposition.

DISTRIBUTION. — Known only from the Norfolk Ridge south of New Caledonia in 1098-1480 m.

REMARKS. — This new species most closely agrees with *K. calvifrons* Iwamoto & Sazonov, 1994 in terms of overall shape, extent of naked areas on snout, and size of upper jaw, snout and interorbital. The two species differ radically in a number of features, with *K. calvifrons* having pelvic fin rays fewer (8), outer ray not extremely elongated, barbel shorter (9% HL), serrations on spinous ray of first dorsal fin well developed, spinous ray not greatly prolonged, dermal windows of light organ developed, and scales smaller.

Source : MNHN, Paris

The spinous dorsal ray in *Kumba gymnorhynchus* Iwamoto & Sazonov, 1994 also lacks serrations, but that ray is much shorter than in the new species. Numerous other features differ between the two, including: pelvic fin ray count (10-11 in *K. gymnorhynchus*), internasal width (22-24% HL), interorbital width (26-27%), orbit diameter (25-26%), postorbital length (48-51%), upper jaw length (40-43%), barbel length (about 7%), outer pelvic ray length (63-67%), and naked area on snout not extending beyond lateral nasal angles.

Kumba punctulata, which has been taken close to the type locality of *K. musorstom*, is a much smaller species with 9-10 pelvic fin rays and many differing proportions in head measurements.

Kumba punctulata Iwamoto & Sazonov, 1994

Kumba punctulata - IWAMOTO & MERRETT, 1997: 526, Fig. 23 (Norfolk Ridge).

MATERIAL EXAMINED. — 3 specimens.

Vanuatu. MUSORSTOM 8: stn CP 975, 19°23.60'S, 169°28.93'E, 566-536 m, 22.09.1994: 1 specimen 21 mm HL (MNHN 1997-721). — Stn CP 1027, 17°53.05'S, 168°39.35'E, 550-571 m, 28.09.1994: 1 specimen 16 mm HL (MNHN 1997-674). — Stn CP 1050, 16°39.20'S, 168°01.30'E, 541-577 m, 1.10.1994: 1 specimen 15 mm HL (MNHN 1997-715).

REMARKS. — The three Vanuatu specimens were a surprise, as only the holotype was present in previous collections reported by IWAMOTO & MERRETT (1997) from the New Caledonian area. Only six specimens of this rare fish are known.

Genus ***KURONEZUMIA*** Iwamoto, 1974

Kuronezumia Iwamoto, 1974: 509 (as subgenus of *Nezumia*).

DIAGNOSIS. — Branchiostegal rays 7; snout rounded in profile, almost entirely covered with small, uniform, finely spinulated scales. Suborbital region vertical, without an angular midlateral ridge, the region covered with small scales and lacking a row of enlarged, modified scales. Upper jaw 30-44% of HL. Jaw teeth in broad villiform bands, bands in lower jaw short and broad. Gill rakers 8-11 total on outer side of second arch. Small patches of scales on branchiostegal rays in most species. Body scales small, adherent, densely covered with long slender spinules. Anus far removed from anal fin, closer to pelvic bases. Anterior dermal window of light organ usually small, situated between pelvic fin bases and separated from anus by a broad scaly area. Colour overall grey to brown to swarthy; fins dusky to blackish, naked membranes blackish to dark grey. Abdominal vertebrae 12-13. (After SAZONOV & IWAMOTO, 1992:64-65).

REMARKS. — Shcherbachev *et al.* (1992) recently reviewed the genus, recognizing seven species, some of which had been variously included in the genera *Nezumia, Ventrifossa, Macruroplus, Lionurus* and *Macrourus*. Only one species is known from the New Caledonian region, but two are known from New Zealand and three from Australia.

Kuronezumia bubonis (Iwamoto, 1974)

Fig. 23

Nezumia (Kuronezumia) bubonis Iwamoto, 1974: 507-516, Figs 1-3 (holotype: CAS 27872 from Gulf of Mexico).
Nezumia bubonis - PAXTON *et al.*, 1989: 328 (New South Wales & Victoria, Australia).
Kuronezumia bubonis - PAULIN *et al.*, 1989: 130 (New Zealand; in key).

MATERIAL EXAMINED. — 1 specimen.

Vanuatu. MUSORSTOM 8: stn CP 1080, 15°57.30'S, 167°27.73'E, 799-850 m, 5.10.1994: 1 specimen 32.8 mm HL, 182+ mm TL (MNHN 1997-716).

Source : MNHN, Paris

DIAGNOSIS. — Head completely and uniformly covered with small, finely spinulated scales; a large scaly swelling of light organ between pelvic fins; V. usually 11-13; scales below 2D. 12-15.

DESCRIPTION (of one specimen). — *Counts*: 1D. II,12; 1P. i21/i23; V. 11/10; GR-I (outer/inner) 5/2+1+7, GR-II 1+1+7/1+8; scales 2D. about 14.

Measurements: snout 8.8 (27); preoral 4.9 (15); internasal 5.9 (18); interorb. 8.0 (24); orb. 10.8 (33); suborb. 5.6 (17); postorb. 15 (46); orb-preop. 11.7 (36); up. jaw 11.6 (35); barbel 6.8 (21); V.-A. 10 (30); body depth 28 (8); depth over A. 21 (64); ht. 1D. 35 (107); len. P. 1 (64); len. V. 18 (55); gill slit 6.0 (18).

SIZE. — A species of large adult size to about 73 cm TL.

DISTRIBUTION. — Widespread, from central western Atlantic, Indian Ocean, southwestern Pacific, and Hawaii. Depth range about 600-1300 m.

REMARKS. — The single juvenile from Vanuatu represents the first record of the species from the New Caledonian region. See SHCHERBACHEV *et al.* (1992) for more references and comparisons with other members of the genus.

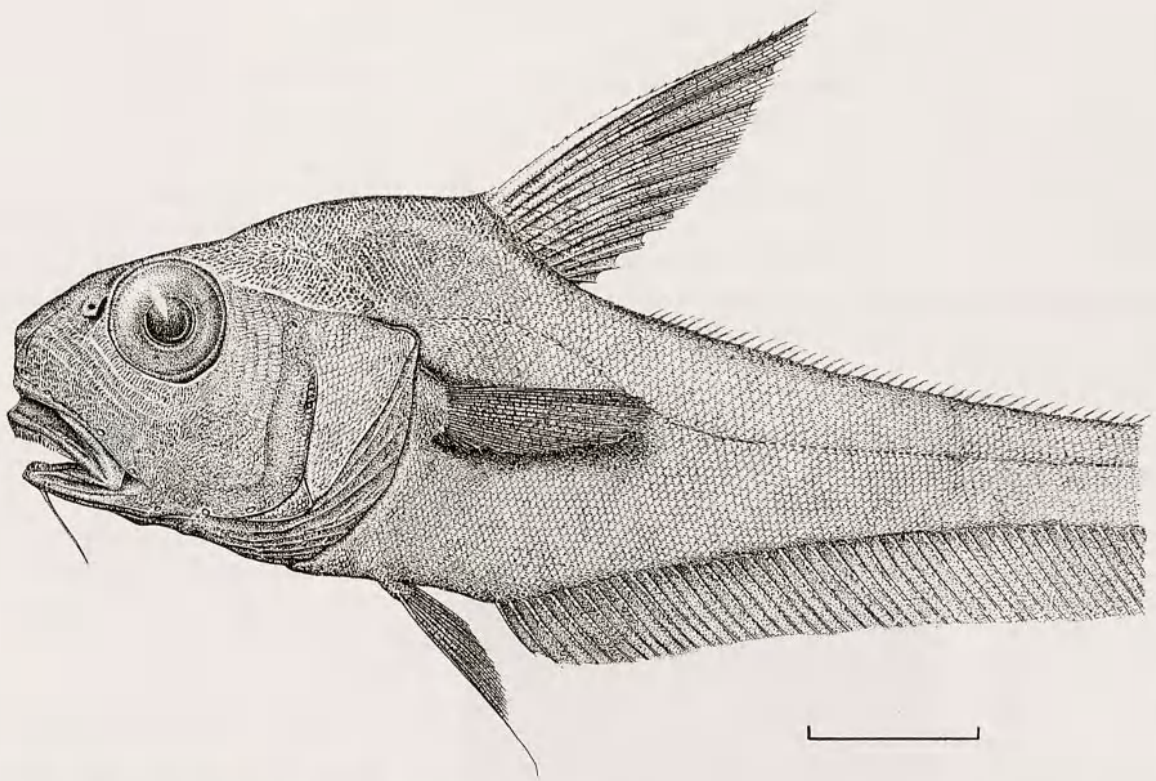

FIG. 23. — *Kuronezumia bubonis* (Iwamoto, 1974). Lateral view of head and trunk of paratype, BPBM uncat., from Hawaii. Scale = 25 mm. From IWAMOTO, 1974, fig. 2. Courtesy of the California Academy of Sciences.

Genus ***LUCIGADUS*** Gilbert & Hubbs, 1920

Lucigadus acrolophus Iwamoto & Merrett, 1997

Lucigadus acrolophus Iwamoto & Merrett, 1997, 526-528, Fig. 24a (New Caledonia, Norfolk Ridge).

Source : MNHN, Paris

MATERIAL EXAMINED. — 6 specimens.

Vanuatu. MUSORSTOM 8: stn CP 980, 19°21.02'S, 169°25.22'E, 450-430 m, 22.09.1994: 3 specimens 23-28 mm HL (MNHN 1995-992). — Stn CP 1137, 15°41.52'S, 167°02.67'E, 360-371 m, 11.10.1994: 1 specimen 13 mm HL (MNHN 1997-675).

Stn unknown but probably from MUSORSTOM 8: 2 specimens 26-34 mm HL (MNHN 1995-967).

REMARKS. — This small species is known only from New Caledonia, Vanuatu, and the Norfolk Ridge north of 22°54'S, in depths of 360-450 m.

Lucigadus microlepis (Günther, 1878)

Fig. 24

Lucigadus microlepis - IWAMOTO & MERRETT, 1997: 528-530, Fig. 24b (New Caledonia, Fiji, Wallis & Futuna Islands, Norfolk Ridge, Indonesia).

MATERIAL EXAMINED. — 21 specimens.

New Caledonia. BATHUS 3: stn CP 833, 23°02.75'S, 166°58.23'E, 441-444 m, 30.11.1993: 3 specimens (MNHN 1995-817).

Vanuatu. MUSORSTOM 8: stn CP 973, 19°21.30'S, 169°27.03'E, 460-480 m, 22.09.1994: 4 specimens 10-23 mm HL (MNHN 1995-867). — Stn CP 974, 19°21.51'S, 169°28.26'E, 492-520 m, 22.09.1994: 3 specimens 17-22 mm HL (MNHN 1995-976). — Stn CP 980, 19°21.02'S, 169°25.22'E, 450-430 m, 22.09.1994: 1 specimen 18 mm HL (MNHN 1995-700). — Stn CP 983, 19°21.61'S, 169°27.76'E, 480-475 m, 23.09.1994: 1 specimen 15 mm HL (MNHN 1997-676). — Stn CP 984, 19°19.62'S, 169°26.43'E, 480-544 m, 23.09.1994: 7 specimens 14-22 mm HL (MNHN 1995-973). — Stn CP 1026, 17°50.35'S, 168°39.33'E, 437-504 m, 28.09.1994: 1 specimen 17 mm HL (MNHN 1995-850).

Norfolk Ridge. HALIPRO 2: stn BT 94, 23°36.7'S, 167°41.66'E, 448-880 m, 24.11.1996: 1 specimen 25 mm HL, 147 mm TL (CAS 90700).

REMARKS. — This species is quite common compared to its congener *Lucigadus acrolophus*. It is widespread from Indonesia to Queensland, Australia (personal data, TI), Fiji, Wallis and Futuna Islands, New Caledonia, Norfolk Ridge, and Vanuatu, in depths ranging from 418-600 m in the Pacific, but only 204-289 m in Indonesian seas. No captures have been recorded south of 25°S.

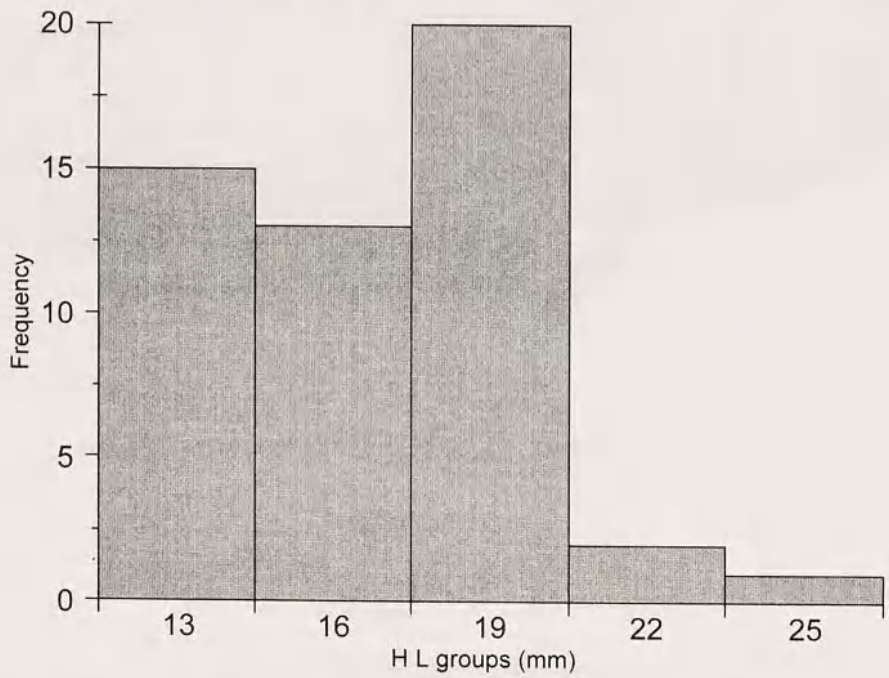

FIG. 24. — Length-frequency (HL, head length mm) distribution of *Lucigadus microlepis* (n = 51).

Source : MNHN, Paris

The majority of the *Lucigadus microlepis* sampled occurred in the 13-19 mm HL group (Fig. 24). Its small adult size was confirmed by ovarian maturation being observed within the range 18-20 mm HL. Males were seen to be macrosmatic and the ovaries of females contained more than one generation of ripening ova. A variety of crustacean prey was found in the stomachs of two of the nine specimens examined (Table 5). These two stomachs were free of sediment, while another contained sediment but no identifiable food items.

Genus ***MACROSMIA*** Merrett, Sazonov & Shcherbachev, 1983

DIAGNOSIS. — A macrourine with seven branchiostegal rays; olfactory organ massive, about 4-5 times in head length; head squamation reduced, mostly lacking on snout and underside of head, no scaled ridges on head and snout; second spinous ray of first dorsal fin weakly serrated; pelvic fins anteriorly placed; anal fin origin below hind margin of first dorsal fin; chin barbel developed; anus within small periproct immediately anterior to anal fin; no light organ; swimbladder well developed with two gas glands and retia; pyloric caeca 15-18. (After MERRETT *et al.*, 1983.)

REMARKS. — A small, rarely caught, deep-living species. Monotypic.

Macrosmia phalacra Merrett, Sazonov & Shcherbachev, 1983

Fig. 25

Macrosmia phalacra Merrett, Sazonov & Shcherbachev, 1983: 554-560, Figs 1-3 (holotype ZMMGU P-15390, Ninety East Ridge, Indian Ocean, 17°04.8'S, 88°09.0'E, 1650-1660 m; paratype from Canary Passage, E. North Atlantic, 1654-1699 m).

MATERIAL EXAMINED. — 1 specimen.

Vanuatu. MUSORSTOM 8: stn CP 1125, 15°57.63'S, 166°38.43'E, 1160-1220 m, 10.10.1994: 1 female 27.9 mm HL, 207+ mm TL (MNHN 1997-724).

DIAGNOSIS. — As for genus.

DESCRIPTION (one specimen). — *Counts*: 1D. II,9; P. i20/i21; V. 12/11; GR-I (outer/inner) 8 / 2+1+7, GR-II 1+1+9 / 2+8; scales below 1D. 5 or 6, below mid-1D. 4, below 2D. 6, lat.line scales over distance equal to predorsal length about 29.

Measurements (in mm followed by value in percent of HL): snout 7.8 (28); preoral 4.7 (17); internasal 4.1 (15); post. nostril 4.5 (16); interorb. 6.0 (2); orb. 8.0 (29); suborb. 3.9 (14); postorb. 13.9 (50); orb.-preop. 10.6 (38); up.jaw 11.5 (41); barbel 5.9 (21); outer gill-slit 4.8 (17); body depth 22 (79); depth over A. origin 19 (68); ht. 1D. 26.5 (95); len. P. 16 (57); len. V. 26 (93); 1D-2D. interspace 8 (29).

Snout blunt, in this specimen appearing to have been somewhat pushed in during capture or preservation; mouth (premaxillary) extends posteriorly to below hind third of orbit. Head compressed, jaws lateral, suborbital vertical and rounded, without sharp ridges. Snout, suborbital, and anterior half of interorbital space naked; naked region extends to lower part of preopercle and onto entire lower jaw. Pores of cephalic lateral line system well developed, especially along ventral margin of suborbital, preopercle, and along mandibular rami. Posterior nostril hugely macrosmastic, diameter about equal to that of pupil. Gill rakers and filaments relatively well developed; rakers tubercular, armed with coarse spinules. Filaments fairly long, about 3 mm. Periproct region relatively narrow, with no indication of a light organ. Ovary large, eggs of various sizes ranging from about 0.1 mm to more than 0.4 mm in diameter.

Snout entirely naked ventrally and dorsally to about midorbit, but some small spinulated scales at lateral angles of snout and posteriorly to below nostrils, continuing onto suborbital shelf to below midorbit. Scales on preopercle, opercle, and subopercle thin, non-spinulated and appearing almost non-imbricate. Lateral line well developed. Body scales small, none enlarged.

Source : MNHN, Paris

Teeth in wide bands, 4-5 teeth wide in both jaws, outermost in premaxillary very slightly enlarged, none in mandibular band enlarged; some mandibular teeth with arrowhead-shaped tip.

Head all black; abdomen black, fins all black or nearly so; upper part of trunk, nape and tail swarthy; mouth and gill cavities black.

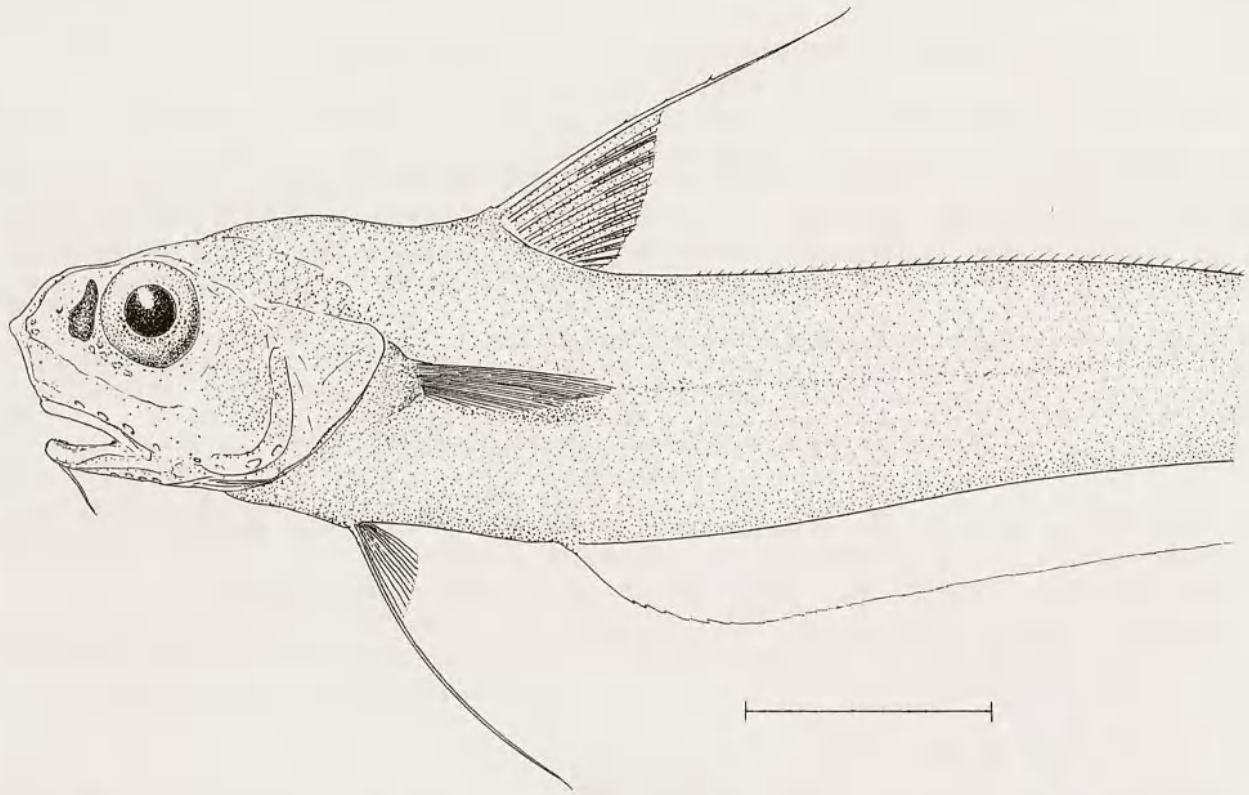

FIG. 25. — *Macrosmia phalacra* Merrett, Sazonov & Shcherbachev, 1983. Holotype, ZMMGU P.15390 (composite of right and left sides of fish; fins and scale pattern reconstructed). Scale = 25 mm.

SIZE. — A species of small adult size, to about 22 cm TL.

DISTRIBUTION. — Eastern North Atlantic, Indian Ocean off Ninety Degree East Ridge, and Vanuatu in southwestern Pacific. Depth range 1160-1699 m.

REMARKS. — MERRETT *et al.* (1983) give a detailed description and discussion of this unusual wide-ranging fish based on two male specimens. Our Vanuatu specimen agrees closely with theirs, which came from the central Indian Ocean and the North Atlantic (27°N). A few differences were found in proportional measurements and counts. Our specimen had 2+1+7 inner gill rakers on the first arch compared with 2+0+10 and 1+1+9 in the type specimens. Scale row count below the first dorsal was 5 or 6 cf. 7 or 8, and below the second dorsal 6 *cf.* 10 in the holotype. The snout was shorter in our specimen (28% HL *cf.* 32 and 34%; preoral 17% cf. 21 and 23%), the orbit diameter slightly longer (29% *cf.* 27 and 21%), and the upper jaw longer (41% *cf.* 34 and 36%). With so few specimens available for comparison, we cannot properly assess the significance of these differences. That our specimen was a maturing female may account for these discrepancies in counts and measurements.

The enormous olfactory organ (Fig. 25) in the female of this species supports the statement of MERRETT *et al.* (1983: 553) that the condition is not a matter of sexual dimorphism, but one that has a phylogenetic basis.

Source : MNHN, Paris

Genus *MALACOCEPHALUS* Günther, 1887

Malacocephalus laevis Lowe, 1843

Malacocephalus laevis - IWAMOTO & MERRETT, 1997: 532, Fig. 25 (Norfolk & Loyalty Ridges, Chesterfield & Bellona Plateau, Wallis & Futuna Islands).

MATERIAL EXAMINED. — 3 specimens.

Vanuatu. MUSORSTORM 8: stn CP 994, 18°47.72'S, 168°56.17'E, 649-641 m, 24.09.1996: 1 specimen 85 mm HL (MNHN 1995-836). — Stn CP 1028, 17°54.01'S, 168°40.42'E, 624-668 m, 8.09.1996: 1 specimen 80 mm HL (MNHN 1995-838), 1 specimen 56 mm HL (MNHN 1995-963).

REMARKS. — This circumglobal species was previously recorded by IWAMOTO & MERRETT (1997: 53) from five specimens collected off the Wallis and Futuna Islands, Chesterfield and Bellona Plateau, and the Norfolk Ridge. It is now known from three specimens from Vanuatu. None was collected during HALIPRO 2.

Genus *MATAEOCEPHALUS* Berg, 1898

Mataeocephalus acipenserinus (Gilbert & Cramer, 1897)

Mataeocephalus acipenserinus - IWAMOTO & MERRETT, 1997: 533-534, Fig. 26 (Chesterfield & Bellona Plateau, Loyalty Islands, Wallis & Futuna Islands).

MATERIAL EXAMINED. — 12 specimens.

Vanuatu. MUSORSTOM 8: stn CP 991, 18°51.6'S, 168°52.19'E, 936-910 m, 24.09.1996: 2 specimens 30.3-42.7 mm HL, 135-182+ mm TL (MNHN 1995-994). — Stn CP 992, 18°52.34'S, 168°55.16'E, 775-748 m, 24.09.1996: 2 specimens, 39.0-52 [snout missing] mm HL, 160-230+ mm TL (MNHN 1997-681). — Stn CP 996, 18°52.41'S, 168°55.73'E, 764-786 m, 24.09.1996: 6 specimens, 31.5-49.6 mm HL, 120+-210+ mm TL (MNHN 1995-881). — Stn CP 1125, 15°57.63'S, 166°38.43'E, 1160-1220 m, 10.10.1996: 1 specimen (MNHN 1997-680).

Wallis and Futuna Islands. MUSORSTOM 7: stn CC 554, 12°13.08'S, 177°28.00'W, 820-795 m, 18.05.1992: 1 specimen 44.4 mm HL, 176+ mm TL (MNHN 1995-667).

REMARKS. — *Mataeocephalus acipenserinus* was captured in small numbers in Vanuatu and other areas within the New Caledonian region. It was rarely taken in quantity in any haul, although six specimens were captured in Stn CP 996. IWAMOTO & MERRETT (1997: 61-62) recorded 11 specimens captured at eight stations from previous MUSORSTOM cruises. No specimens were collected during HALIPRO 2, suggesting that the species may be confined to waters north of about 21°S. In a juvenile (30.3 mm HL) from MNHN 1995-994, the trunk and tail had a banding pattern much as that seen in juveniles of *Malacocephalus laevis*.

Mataeocephalus adustus Smith & Radcliffe, 1912

Fig. 26

Mataeocephalus adustus Smith & Radcliffe *in* RADCLIFFE, 1912: 126-127, pl. 28, Fig. 3 [holotype USNM 72943, from off Celebes in 805 fathoms (1472 m)].

MATERIAL EXAMINED. — 2 specimens.

Vanuatu. MUSORSTOM 8: stn CP 1037, 18°03.70'S, 168°54.40'E, 1058-1086 m, 29.09.1996: 1 specimen 43.0 mm HL, 183+ mm TL (MNHN 1995-854). — Stn CP 1076, 15°53.81'S, 167°30.42'E, 1100-1191 m, 4.10.1994: 1 specimen 61.8 mm HL, 307+ mm TL (MNHN 1995-846).

Source : MNHN, Paris

DIAGNOSIS. — V. 7; P. i17-i19; underside of head mostly scaled; periproct region close before anal-fin origin, no separate dermal window anteriorly; spinous second ray of first dorsal fin greatly elongated (to as much as twice length of head), serrations along leading edge rudimentary or absent.

DESCRIPTION (two specimens). — *Counts*: 1D. II,9; GR-I (outer/inner) 0 / 7-9 total, GR-II 1+7 / 1+7; scales below 1D. 7.5-8, mid-1D. 4.5-5.0, 2D. 6.5, lat.line 34-37.

Measurements (in percent HL): snout 37-39; preoral 30-35; internasal 21-25; interorb. 20-22; orb. 23-24; suborb. 15-16; postorb. 40-41; orb-preop. 38-40; up. jaw 24-27; barbel 5-7; gill slit 8-9; V.-A. 34-35; body depth 63; depth over A. 49; ht. 1D. 107-157; len. P. 52-64; len. V. 53-55.

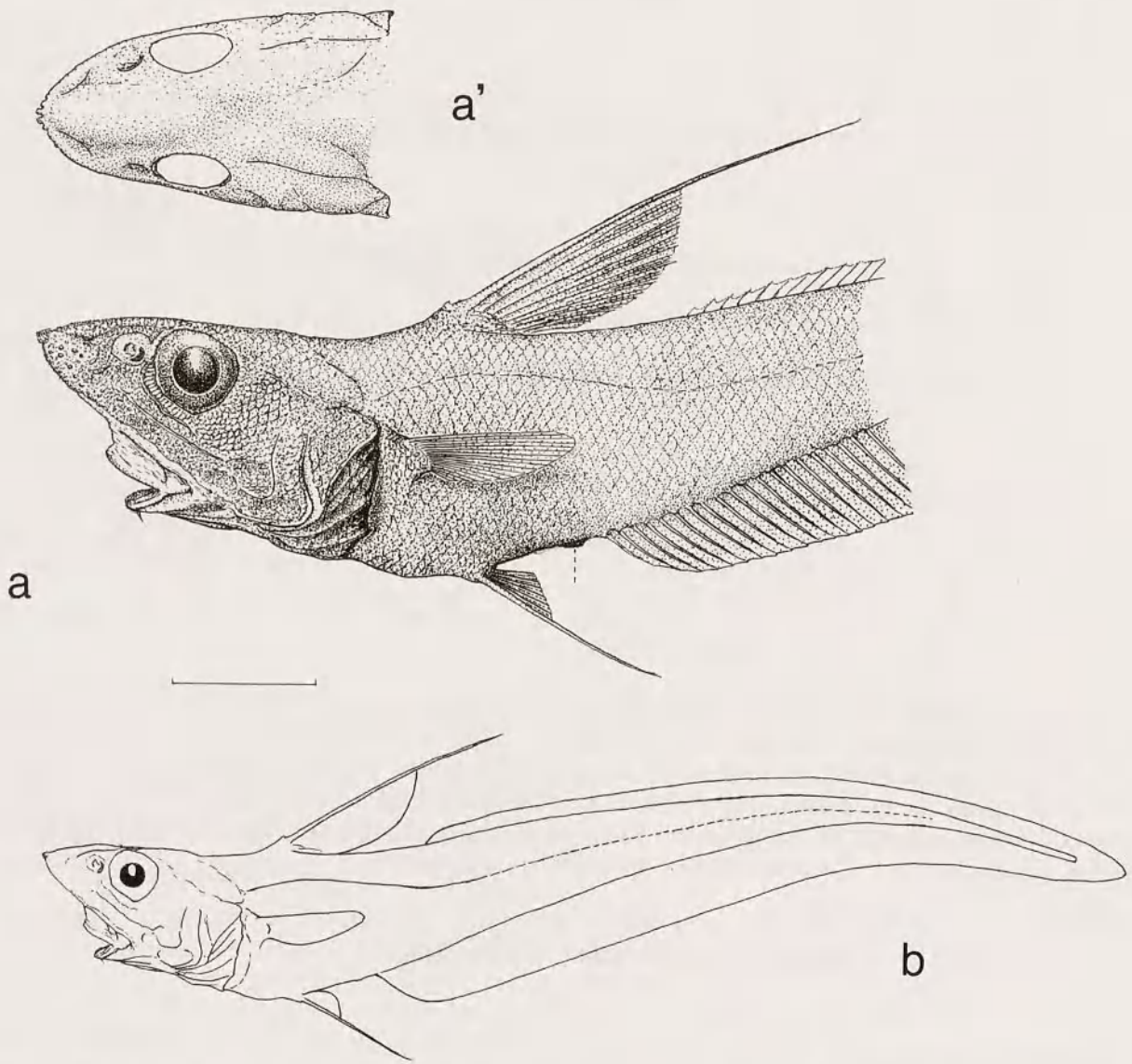

FIG. 26. — *Mataeocephalus adustus* Smith & Radcliffe, 1912. MNHN 1995-846 from off Vanuatu. (**a**) Lateral view of head and trunk; (**a'**) dorsal view of head; (**b**) diagrammatic lateral view. Scale for (a) and (a') = 25 mm.

Head large, slightly inflated in fresh specimens with most surfaces broadly rounded. Body slender, greatest depth about 1.6-1.7 into head length, about eight into total length. Snout in dorsal view triangular anterior to nostrils, sharp creases dorsally behind leading edge, shallowly triangular in lateral view, projecting well beyond small

Source : MNHN, Paris

mouth; tipped with two small tubercular scales. Head ridges smoothly rounded in fresh specimen, but suborbital ridge acute and forming relatively sharp angle between dorsal and ventral surfaces. Gill arches greatly restricted dorsally and ventrally, with outermost gill slit small; no rakers on outer side of first arch; rakers on inner side tubercular, with rather long spinules. Chin barbel short, almost rudimentary; gill membranes broadly united across isthmus.

Premaxillary teeth band short, broad, falling well short of end of rictus, outer series of teeth scarcely enlarged; mandibular band longer, tapered to one row posteriorly.

Body scales with short, needlelike spinules in quincunx or slightly convergent pattern. Scales end abruptly under gill cover. Underside of head uniformly scaled except for thin naked strips along suborbital and preopercle ridges, along median ventral line of snout, and along ventral margins of suborbital and preopercle; entire interopercle naked. Mandibular rami broadly naked but a patch of scales on middle at posterior end.

First dorsal fin high with greatly prolonged second spinous ray; weak serrations proximally along leading edge of ray or edge smooth. Origins of first dorsal and pelvic fins about on same vertical, origin of pectoral fin in advance of that vertical; origin of anal fin well behind vertical through hind margin of first dorsal fin. Outer pelvic fin ray slightly elongated, extending just beyond anal fin origin.

Anus separated by a short gap from anal fin origin, much closer to anal fin origin than to pelvic fin bases. Periproct region small, about diameter of nasal fossa, narrow, raised; light organ small.

Mouth dark. Fins all blackish. Ground color on body and tail swarthy to gray-brown, abdomen darker. Opercle and branchiostegal membranes blackish; gular membrane somewhat paler.

REMARKS. — Only two specimens of this rare species of *Mataeocephalus* were captured. The species is close to an undescribed species recorded as *Mataeocephalus* sp. by IWAMOTO & MERRETT (1997: 62) from the Loyalty Islands and the Chesterfield and Bellona Plateau, but that species has only six branchiostegal rays, a vent that is far removed from the anal fin and closer to the pelvic fin bases, a shorter snout (32-33% HL), and lanceolate scale spinules. Both species have an almost completely scaled underside of head and relatively short snout for a *Mataeocephalus*. *Mataeocephalus adustus* can be distinguished from *M. acipenserinus* by its shorter preoral length (28-35% *cf.* 38-40% in *M. acipenserinus*), longer postorbital length (39-41% *cf.* 31-35%), longer orbit to preopercle (38-41% *cf.* 30-36%), and longer upper jaw (24-29% *cf.* 21-23%) [additional measurements for *M. adustus* provided by Y. I. SAZONOV, ZMMGU].

Mataeocephalus sp.

Mataeocephalus sp. Sazonov & Shcherbachev MS - IWAMOTO & MERRETT, 1997: 62-63, Fig. 7 (6 spec., Loyalty Islands and Chesterfield and Bellona Plateau; 412-970 m).

MATERIAL EXAMINED. — 20 specimens.

Vanuatu. MUSORSTOM 8: stn CP 992, 18°52.34'S, 168°55.16'E, 775-748 m, 24.09.1994: 1 specimen 44 mm HL (MNHN 1997-679). — Stn CP 993, 18°48.78'S, 168°54.04'E, 780-783 m, 24.09.1994: 1 specimen 33 mm HL (MNHN 1995-969). — Stn CP 996, 18°52.41'S, 168°55.73'E, 764-786 m, 24.09.1994: 12 specimens 30-46 mm HL (MNHN 1997-678). — Stn CP 1008, 18°53.29'S, 169°52.65'E, 919-1000 m, 25.09.1994: 3 specimens 17-32 mm HL (MNHN 1995-978). — Stn CP 1034, 17°54.85'S, 168°42.04'E, 690-750 m, 29.09.1994: 1 specimen 41 mm HL (MNHN 1995-874). — Stn CP 1074, 15°48.42'S, 167°24.27'E, 775-798 m, 4.10.1994: 1 specimen 51 mm HL (MNHN 1995-856). — Stn CP 1125, 18°52.41'S, 168°55.73'E, 764-786 m, 10.10.1994: 1 specimen 39 mm HL (MNHN 1997-677).

REMARKS. — The species was not recorded from HALIPRO 2, but was captured seven times in Vanuatu waters.

Genus ***NEZUMIA*** Jordan, 1904

Nezumia aspidentata Iwamoto & Merrett, 1997

This rarely caught species was not represented in current collections.

Source : MNHN, Paris

Nezumia cliveri Iwamoto & Merrett, 1997

Nezumia cliveri Iwamoto & Merrett, 1997: 539-540, Fig. 28c (Norfolk & Loyalty Ridges).

MATERIAL EXAMINED. — 1 specimen.

Norfolk Ridge. HALIPRO 2: stn BT 42, 25°34.29'S, 167°25.08'E, 1132-1160 m, 16.11.1996: 1 specimen (CAS 90751).

REMARKS. — This species is known only from three specimens taken off the Norfolk and Loyalty Ridges.

Nezumia coheni Iwamoto & Merrett, 1997

Nezumia coheni Iwamoto & Merrett, 1997: 540-541, Fig. 28b (New Caledonia, Norfolk & Loyalty Ridges, Kermadec Islands, Australia).

MATERIAL EXAMINED. — 5 specimens.

Loyalty Ridge. HALIPRO 2: stn BT 15, 24°36.28'S, 170°03.85'E, 900-1005 m, 8.11.1996: 1 specimen 52.7 mm HL, 305+ mm TL (MNHN 1998-230).

Norfolk Ridge. HALIPRO 2: stn BT 46, 25°41.99'S, 167°25.6'E, 1230-1268 m, 15.11.1996: 1 specimen 57.1 mm HL, 331 mm TL (BMNH 1997.5.21.45). — Stn BT 55, 25°02.85'S, 168°45.42'E, 1098-1480 m, 17.11.1996: 1 specimen 66.2 mm HL, 361 mm TL (MNHN 1998-324). — Stn BT 75, 24°13.17'S, 167°36.52'E, 1128-1150 m, 21.11.1996: 1 specimen 51.5 mm HL, 302+ mm TL (paratype, CAS 90614). 1 specimen (NMNZ P.34253).

Lord Howe Rise. HALIPRO 2: stn BT 104, 25°23.01'S, 162°35.4'E, 1118-1124 m, 27.11.1996: 1 specimen (paratype, CAS 90668).

REMARKS. — Known from relatively small numbers in New Caledonian waters, but fairly common off east coast of Australia.

Nezumia propinqua (Gilbert & Cramer, 1897)

?*Nezumia propinqua* - IWAMOTO & MERRETT, 1997: 541-542, Fig. 29a (New Caledonia, Norfolk & Loyalty Ridges, Chesterfield & Bellona Plateau, Wallis & Futuna Islands). — GRANDPERRIN *et al.*, 1997: 117 (New Caledonia; list).

MATERIAL EXAMINED. — 25 specimens.

Vanuatu. MUSORSTOM 8: stn CP 970, 20°18.56'S, 169°53.19'E, 25-310 m, 21.09.1994: 1 specimen (MNHN 1997-702). — Stn CP 991, 18°51.26'S, 168°52.19'E, 936-910 m, 24.09.1994: 2 specimens (MNHN 1995-991). — Stn CP 992, 18°52.34'S, 168°55.16'E, 775-748 m, 24.09.1994: 1 specimen 124 mm HL (MNHN 1995-970). — Stn CP 993, 18°48.78'S, 168°54.04'E, 780-783 m, 24.09.1994: 1 specimen 33 mm HL (MNHN 1997-695). — Stn CC 996, 18°52.41'S, 168°55.73'E, 764-786 m, 24.09.1994: 4 specimens (MNHN 1997-682). — Stn CP 1008, 18°53.29'S, 169°52.65'E, 919-1000 m, 25.09.1994,: 2 specimens (MNHN 1997-696). — Stn DW 1012, 17°53.24'S, 168°13.09'E, 775-740 m, 27.09.1994: 1 specimen (MNHN 1996-482). — Stn CP 1033, 17°54.75'S, 168°40.66'E, 650-691 m, 29.09.1994: 1 specimen (MNHN 1995-958). — Stn CP 1034, 17°54.85'S, 168°42.04'E, 690-750 m, 29.09.1994: 1 specimen (MNHN 1995-975). — Stn CP 1035, 17°56.02'S, 168°44.06'E, 765-780 m, 29.09.1994: 1 specimen (MNHN 1997-699). — Stn CP 1036, 18°01.00'S, 168°48.20'E, 920-950 m, 29.09.1994: 1 specimen (MNHN 1995-968). — Stn CC 1056, 16°33.11'S, 167°55.64'E, 602-620 m, 1.10.1994: 4 specimens (MNHN 1997-692). — Stn CP 1080, 15°57.30'S, 167°27.73'E, 799-850 m, 5.10.1994: 2 specimens (MNHN 1995-858).

New Caledonia. MUSORSTOM 7: stn CP 623, 12°34.02'S, 178°15'W, 1300-1280 m, 28.05.1992: 1 specimen (MNHN 1997-686).

BATHUS 1: stn CP 660, 21°10.48'S, 165°53.19'E, 786-800 m, 13.03.1993: 1 specimen (MNHN 1997-688).

Lord Howe Rise. HALIPRO 2: stn BT 102, 24°32.97'S, 161°53.65'E, 1060-1130 m, 26.11.1996: 1 specimen 27 mm HL, 161 mm TL (CAS 90747).

REMARKS. — Widespread in the Pacific and Indian Oceans; fairly common off New Caledonia.

Nezumia spinosa (Gilbert & Hubbs, 1916)

Nezumia spinosa - IWAMOTO & MERRETT, 1997: 52-545, Fig. 29b (Norfolk & Loyalty Ridges, Wallis & Futuna Islands, Japan).

Source : MNHN, Paris

MATERIAL EXAMINED. — 1 specimen.
Norfolk Ridge. HALIPRO 2: stn BT 35, 25°23'S, 168°56.99'E, 640-740 m, 12.11.1996: 1 specimen 45 mm HL, 250+ mm TL (CAS 90698).

REMARKS. — A widespread Indo-West Pacific species, uncommon in New Caledonian waters.

Genus *PSEUDONEZUMIA* Okamura, 1970

Pseudonezumia parvipes (Smith & Radcliffe, 1912)

This species was not represented in recent collections.

Pseudonezumia pusilla (Sazonov & Shcherbachev, 1982)

Pseudonezumia pusilla - IWAMOTO & MERRETT, 1997:547-548, Fig. 30b (1 spec., Loyalty Islands).

MATERIAL EXAMINED. — 1 specimen.
Vanuatu. MUSORSTOM 8: stn CP 1125, 15°57.63'S, 166°38.43'E, 1160-1220 m, 10.10.1994: 1 specimen 31.7 mm HL (MNHN 1997-725).

REMARKS. — The Vanuatu specimen is only the second known from the New Caledonian region, the first having been collected on the Loyalty Ridge. The species is uncommon but widespread in the tropical Indo-Pacific.

Genus *SPHAGEMACRURUS* Fowler, 1925

Sphagemacrurus pumiliceps (Alcock, 1894)

Sphagemacrurus pumiliceps - IWAMOTO & MERRETT, 1997: 549-550, Fig. 31a (New Caledonia, Loyalty Islands, Chesterfield & Bellona Plateau, Wallis & Futuna Islands). — GRANDPERRIN *et al.*, 1997: 117 (New Caledonia; list).

MATERIAL EXAMINED. — 24 specimens.
Vanuatu. MUSORSTOM 8: stn CP 990, 18°51.63'S, 168°50.98'E, 980-990 m, 24.09.1994: 2 specimens 24-32 mm HL (MNHN 1995-997). — Stn CP 991, 18°51.26'S, 168°52.19'E, 936-910 m, 24.09.1994: 1 specimen 32 mm HL (MNHN 1997-701). — Stn CP 992, 18°52.34'S, 168°55.16'E, 775-748 m, 24.09.1994: 1 specimen 33 mm HL (MNHN 1997-683). — Stn CP 996, 18°52.41'S, 168°55.19'E, 764-786 m, 24.09.1994: 4 specimens 27-34 mm HL (MNHN 1995-977). — Stn CP 1008, 18°53.29'S, 169°52.65'E, 919-1000 m, 24.09.1994: 3 specimens 15-33 mm HL (MNHN 1997-717). — Stn CP 1037, 18°03.70'S, 168°54.40'E, 1058-1086 m, 29.09.1994: 1 specimen 30 mm HL (MNHN 1995-982). — Stn CP 1075, 15°53.26'S, 167°27.21'E, 956-944 m, 4.10.1994: 1 specimen 37 mm HL (MNHN 1995-859).
New Caledonia. BATHUS 1: stn CP 660, 21°10.48'S, 165°53.19'E, 786-800 m, 13.03.1993: 4 specimens 20-34 mm HL (MNHN 1997-689).
Norfolk Ridge. HALIPRO 2: stn BT 55, 25°02.85'S, 168°45.42'E, 1098-1480 m, 17.11.1996: 3 specimens 30-38 mm HL, 162+-275 mm TL (MNHN 1998-240), 1 specimen 35 mm HL, 203+ mm TL (CAS 90754). — Stn BT 58, 25°04.13'S, 168°45.21'E, 1303-1500 m, 17.11.1996: 1 specimen 31.5 mm HL, 250 mm TL (CAS 90750).
Lord Howe Rise. HALIPRO 2: stn BT 104, 25°23.01'S, 162°35.4'E, 1118-1124 m, 27.11.1996: 2 specimens 18-27 mm HL, 138-1161+ mm TL (CAS 90854).

REMARKS. — *Sphagemacrurus pumiliceps* is a widespread Pacific and Indian Ocean species taken on numerous occasions (but never in quantity) in the Vanuatu and New Caledonian regions. It was captured only three times during HALIPRO 2, possibly owing to the larger trawl used during that cruise.

Genus *TRACHONURUS* Günther, 1887

Trachonurus gagates Iwamoto & McMillan, 1997

Fig. 27

Trachonurus gagates Iwamoto & McMillan, 1997: 255-259, Figs 1-2 (Australia & New Zealand).

Source : MNHN, Paris

MATERIAL EXAMINED. — 1 specimen.
Lord Howe Rise. HALIPRO 2: stn BT 104, 25°23.01'S, 162°35.4'E, 1118-1124 m, 27.11.1996: 1 specimen, 56 mm HL, 395+ mm TL (CAS 90666).

DIAGNOSIS. — Grooved lateral line absent; least number of scale rows from pelvic fin base to gill cover 11-14; snout bluntly rounded, scarcely protruding beyond mouth; chin barbel 4-8% HL; suborbital width 13-15% HL; color dark brown to blackish overall.

SIZE. — Attains about 48 cm TL.

DISTRIBUTION. — Australia, New Zealand, New Caledonia EEZ off Lord Howe Rise. Depth range 801 to 1240 m.

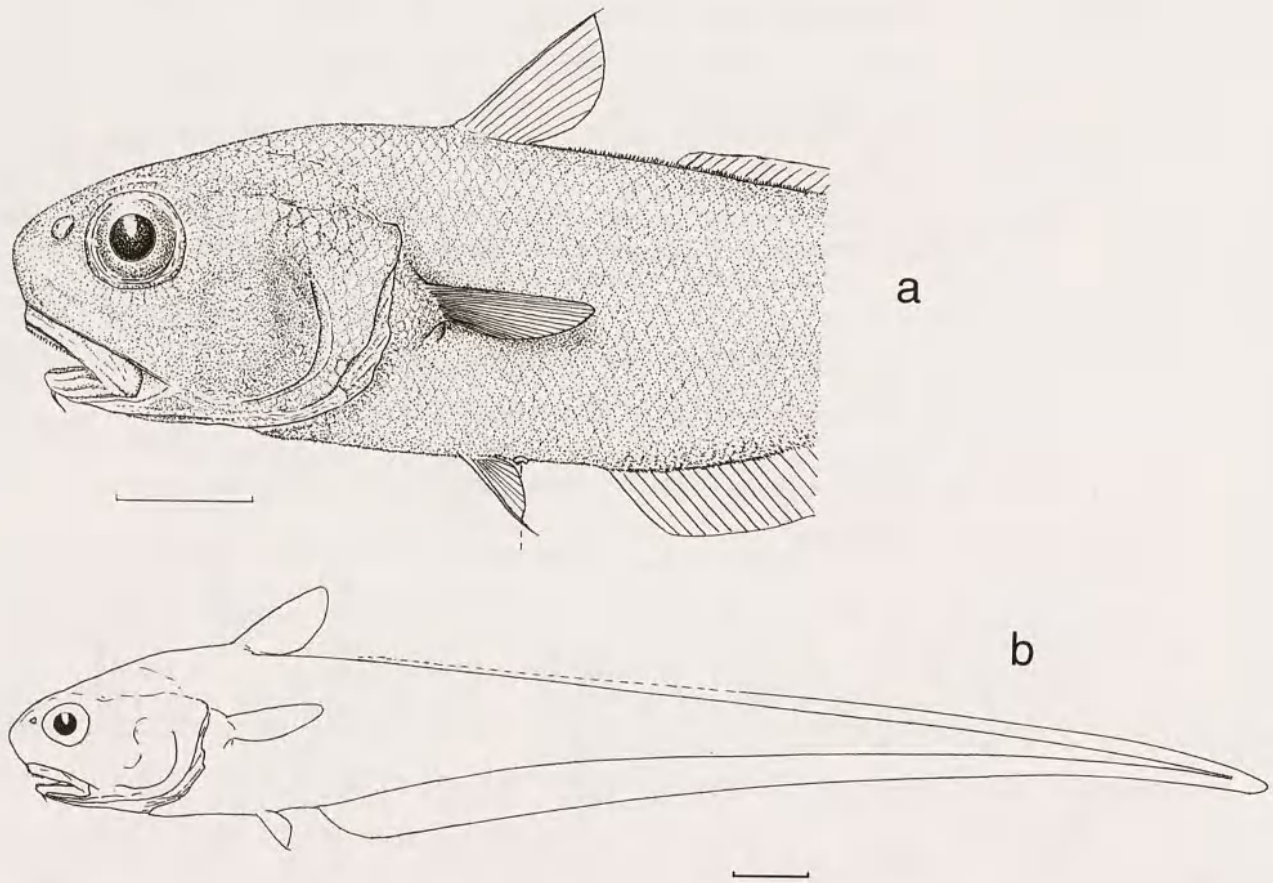

FIG. 27. — *Trachonorus gagates* Iwamoto & McMillan, 1997: (**a**), Lateral view of head and trunk of holotype (AMS I.24059-009; 70.2 mm HL, 430+ mm TL) from off New South Wales, Australia, in 978 m depth; (**b**), Paratype, CAS 82134 (40 cm TL), from off New South Wales, Australia, in 1150 m. Scale = 25 mm.

REMARKS. — See original description for figure and detailed description and comparisons with other species. *Trachonurus gagates* is relatively common at appropriate depths off almost the entire coast of Australia and New Zealand. The HALIPRO 2 specimen is the first and only record from the New Caledonia region, where it is apparently at the northern limit of its range. Off eastern Australia the species is known from off Queensland as far north as latitude 18°S, but off Western Australia, its range extends northward only to 33°16'S.

The number of *Trachonurus* species represented in the New Caledonian region is yet to be fully resolved, as IWAMOTO & MERRETT (1997: 552) have recorded four specimens that may represent an undescribed species, similar to or identical with a species found in Australian waters.

Source : MNHN, Paris

Trachonurus sentipellis (Gilbert & Cramer, 1897)

Trachonurus sentipellis - IWAMOTO & MERRETT, 1997: 551-55, Fig. 31b (Hawaii, New Caledonia, Loyalty Islands, Chesterfield & Bellona Plateau, Wallis & Futuna Islands). — GRANDPERRIN *et al.*, 1997: 117 (New Caledonia; list).

MATERIAL EXAMINED. — 6 specimens.

Vanuatu. MUSORSTOM 8: stn CP 990, 18°51.63'S, 168°50.98'E, 980-990 m, 24.09.1994: 1 specimen (MNHN 1995-880). — Stn CP 991, 18°51.26'S, 168°52.19'E, 936-910 m, 24.09.1994: 1 specimen (MNHN 1995-875). — Stn CP 1125, 18°52.41'S, 168°55.73'E, 764-786 m, 10.10.1994: 1 specimen (MNHN 1995-902). — Stn CP 1129, 16°00.73'S, 166°39.94'E, 1014-1050 m, 10.10.1994: 1 specimen (MNHN 1995-857).

Loyalty Ridge. HALIPRO 2: stn BT 28, 25°23.65'S, 170°29.86'E, 960-1011 m, 11.11.1996: 1 specimen 78 mm HL, 415+ mm TL (CAS 90867).

Norfolk Ridge. HALIPRO 2: stn BT 75, 24°13'S, 167°36'E, 1128-1150 m, 21.09.1996: 1 specimen 66 mm HL, 375+ mm TL (CAS 90745).

REMARKS. — The species is relatively uncommon off New Caledonia and rarely taken in numbers. The Loyalty Ridge specimens are the farthest south *T. sentipellis* has been captured.

Genus ***VENTRIFOSSA*** Gilbert & Hubbs, 1920

Ventrifossa atherodon (Gilbert & Cramer, 1897)

Ventrifossa atherodon - IWAMOTO & MERRETT, 1997: 554-556, Fig. 33a (New Caledonia, Chesterfield & Bellona Plateau, Norfolk & Loyalty Ridges, Wallis & Futuna Islands).

MATERIAL EXAMINED. — 18 specimens.

Vanuatu. MUSORSTOM 8: stn CP 993, 18°48.78'S, 168°54.04'E, 780-783 m, 24.09.1994: 2 specimens 50.4-59.0 mm HL, 215+-310 mm TL (MNHN 1995-834). — Stn CC 996, 18°52.41'S, 168°55.73'E, 764-786 m, 24.09.1994: 5 specimens 56.6-68.7 mm HL, 280+-320+ mm TL (MNHN 1995-903), 1 specimen 28.7 mm HL, 152+ mm TL (MNHN 1997-714). — Stn CP 1028, 17°54.01'S, 168°40.42'E, 624-668 m, 28.09.1994: 1 specimen 62.7 mm HL (MNHN 1995-904). — Stn CP 1033, 17°54.75'S, 168°40.66'E, 650-691 m, 29.09.1994: 2 specimens 57.5-61.0 mm HL, 312+-307+ mm TL (MNHN 1995-901), 1 specimen 22.7 mm HL, 120+ mm TL (MNHN 1997-719). — Stn CP 1035, 17°56.02'S, 168°44.06'E, 765-780 m, 29.09.1994: 5 specimens 31.7-52.4 mm HL (MNHN 1995-990). — Stn CP 1036, 18°01.00'S, 168°48.20'E, 920-950 m, 29.09.1994: 1 specimen 53.0 mm HL, 290+ mm TL (MNHN 1995-865).

REMARKS. — This species was captured in several trawls off Vanuatu, but it was absent during the HALIPRO 2 cruise even though it was taken off the Norfolk and Loyalty Ridges on previous cruises.

Ventrifossa johnboborum Iwamoto, 1982

Ventrifossa johnboborum - IWAMOTO & MERRETT, 1997: 556-557, Fig. 34 (New Caledonia, Norfolk and Loyalty Ridges, Chesterfield and Bellona Plateau, Wallis and Futuna Islands). — GRANDPERRIN *et al.*, 1997: 117 (New Caledonia; list).

MATERIAL EXAMINED. — 14 specimens.

Vanuatu. MUSORSTOM 8: stn CP 996, 18°52.4'S, 168°55.73'E, 764-786 m, 24.09.1996: 1 female specimen, 36 mm HL, 153+ mm TL (MNHN 1997-685). — Stn CP 1035, 17°56.02'S, 168°44.06'E, 765-780 m, 29.09.1994: 1 specimen 26 mm HL, 130+ mm TL (MNHN 1997-722).

New Caledonia. BATHUS I: stn CP 663, 20°58.66'S, 165°38.27'E, 755 m, 13.03.1993: 1 male specimen 56.2 mm HL, 256+ mm TL (MNHN 1995-811) [large *Diaphus* lanternfish in stomach].

Loyalty Ridge. HALIPRO 2: stn BT 07, 23°41.49'S 169°54.4'E, 897-994 m, 7.11.1996: 1 specimen 104 mm HL, 400+ mm TL (MNHN 1998-238). — Stn BT 13, 24°18.03'S, 169°57.5'E, 805-835 m, 8.11.1996: 1 specimen 95 mm HL, 485+ mm TL (MNHN 1998-248). — Stn BT 17, 24°34.35'S, 170°11.45'E, 935-936 m, 8.11.1996: 1 specimen 103 mm HL, 500+ mm TL (MNHN 1998-321). — Stn BT 18, 24°34.42'S, 170°12.62'E, 946-988 m, 9.11.1996: 1 specimen 84 mm HL (CAS 90688), 1 specimen (MNHN 1998-249).

Source : MNHN, Paris

Norfolk Ridge. HALIPRO 2: stn BT 62, 24°41.63'S, 168°38.98'E, 720-1048 m, 18.11.1996: 1 specimen 89 mm HL, 450+ mm TL (MNHN 1998-241), 3 specimens (CAS 90672). — Stn BT 64, 24°41.54'S, 168°40.88'E, 800-1240 m, 19.11.1996: 1 specimen (CAS 90669).

Lord Howe Rise. HALIPRO 2: stn BT 101, 24°16.82'S, 161°45.05'E, 970-1063 m, 26.11.1996: 1 specimen (CAS 90665).

REMARKS. — A widespread species, taken in 10 trawls during HALIPRO 2, but never more than four specimens in a trawl.

Ventrifossa macropogon Marshall, 1973

Ventrifossa macropogon - IWAMOTO & MERRETT, 1997: 557-559, Fig. 35 (New Caledonia, Norfolk & Loyalty Ridges). — GRANDPERRIN *et al.*, 1997: 117 (New Caledonia; list).

MATERIAL EXAMINED. — 2 specimens.

Norfolk Ridge. HALIPRO 2: stn BT 35, 25°23'S, 168°56.99'E, 640-740 m, 12.11.1996: 2 specimens 45-52 mm HL, 250+-305+ mm TL (MNHN 1998-254).

Ventrifossa nigrodorsalis Gilbert & Hubbs, 1920

Fig. 28

Ventrifossa nigrodorsalis - IWAMOTO & MERRETT, 1997: 559-562, figs. 36, 37a (38 spec., New Caledonia, Norfolk & Loyalty Ridges, Loyalty Islands, Chesterfield & Bellona Plateau).

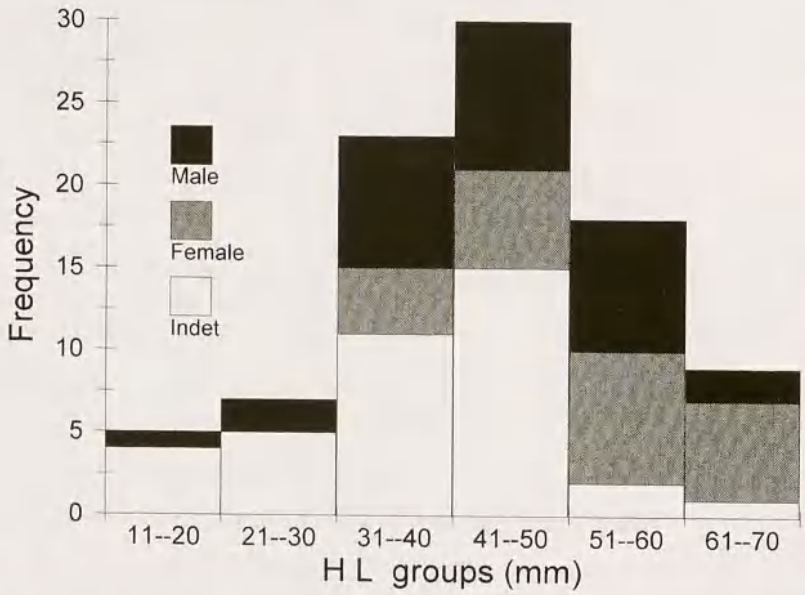

FIG. 28. — Length-frequency (HL, head length mm) distribution of *Ventrifossa nigrodorsalis* by sex (n = 92).

MATERIAL EXAMINED. — 32 specimens.

Vanuatu. MUSORSTOM 8: stn CP 975, 19°23.60'S, 169°28.93'E, 566-536 m, 22.09.1994: 1 specimen 44.3 mm HL, 232+ mm TL (MNHN 1995-966) and 1 specimen 35.0 mm HL, 187+ mm TL (MNHN 1995-985). — Stn CP 994, 18°47.72'S, 168°56.17'E, 649-641 m, 24.09.1994: 1 specimen 19.1 mm HL 112 mm TL (ex MNHN 1995-873). — Stn CC 996, 18°52.41'S, 168°55.73'E, 764-786 m, 24.09.1994: 4 specimens 52.4-64.5 mm HL, 251+-344+ mm TL (MNHN 1995-903). — Stn CP 1007, 18°51.97'S, 168°55.92'E, 720-830 m, 25.09.1994: 4 specimens 21.4-55.6 mm HL, 108+-281+ mm TL (MNHN 1995-885). — Stn CP 1033, 17°54.75'S, 168°40.66'E, 650-691 m, 29.09.1994: 1 specimen 48.9 mm HL, 255+ mm TL (MNHN 1995-521). — Stn CP 1035, 17°56.02'S, 168°44.06'E, 765-780 m, 29.09.1994: 1 specimen 66.4 mm HL, 325+ mm TL (ex MNHN 1995-990). — Stn CP 1053, 16°29.3'S 167°58.70'E, 536-519 m, 1.10.1994: 1 specimen 43.6 mm HL, 232+ mm TL (MNHN 1995-868). — Stn CP 1054, 16°27.95'S,

Source : MNHN, Paris

167°57.44'E, 522-527 m, 1.10.1994: 1 specimen 40.7 mm HL, 232+ mm TL (MNHN 1995-848), 1 specimen 23.5 mm HL 145 mm TL (MNHN 1995-983). — Stn CP 1055, 16°30.11'S, 167°55.13'E, 572-580 m, 1.10.1994: 1 specimen 44.2 mm HL, 145+ mm TL (MNHN 1995-871). — Stn CP 1056, 16°33.11'S, 167°55.64'E, 602-620 m, 1.10.1994: 4 specimens (MNHN 1995-842). — Stn CP 1124, 15°01.7'S, 166°56.51'E, 532-599 m, 9.10.1994.

New Caledonia. BATHUS 1: stn CP 657, 21°14.45'S, 165°54.93'E, 490-530 m, 12.03.1993: 1 specimen 46.9 mm HL, 257+ mm TL (MNHN 1995-819). — Stn CP 660, 21°10.48'S, 165°53.19'E, 786-800 m, 13.03.1993: 2 specimens 54.3-60.1 mm HL, 255+-309+ mm TL (MNHN 1995-821). — Stn CP 671, 20°51.18'S, 165°28.17'E, 450-470 m, 14.03.1993: 6 specimens 27.1-160.2 mm HL, 115+-332+ mm TL (MNHN 1995-814). — Stn CP 708, 21°43.05'S, 166°38.57'E, 550-580 m, 19.03.1993: 1 specimen 53.8 mm HL, 300+ mm TL (MNHN 1995-822).

Wallis and Futuna Islands. MUSORSTOM 7: stn CP 623, 12°34.2'S, 178°15.1'W, 1300-1280 m, 28.05.1992: 1 specimen 38.9 mm HL, 225+ mm TL (ex MNHN 1995-811).

REMARKS. — Another widespread, abundant species of the western Pacific. The overall length-frequency distribution of specimens among the total collection (Fig. 28) indicates a uinmodal pattern, with no apparent sexual dimorphism in size over the range sampled.

Ventrifossa paxtoni Iwamoto & Williams, 1999

Ventrifossa species (NSW) - IWAMOTO & MERRETT, 1997: 564-565, Fig. 33b (12 spec., New Caledonia, Chesterfield and Bellona Plateau).
Ventrifossa paxtoni Iwamoto & Williams, 1999: 228-231, Fig. 55.

MATERIAL EXAMINED. — 59 specimens.

Vanuatu. MUSORSTOM 8: stn CP 975, 19°23.60'S, 169°28.93'E, 566-536 m, 22.09.1994: 1 specimen 63 mm HL, 327 mm TL (MNHN 1995-966). — Stn CP 991, 18°51.26'S, 168°52.19'E, 936-910 m, 24.09.1994: 1 specimen 86 mm HL, 485 mm TL (MNHN 1995-882), 1 specimen 63.1 mm HL, 327+ mm TL (MNHN 1995-996). — Stn CP 994, 18°47.72'S, 168°56.17'E, 649-641 m, 24.09.1994: 1 specimen (MNHN 1997-718). — Stn CC 996, 18°52.41'S, 168°55.73'E, 764-786 m, 24.09.1994: 4 specimens (MNHN 1997-581). — Stn CP 1007, 18°51.97'S, 168°55.92'E, 720-830 m, 25.09.1994: 4 specimens (MNHN 1995-885). — Stn CP 1033, 17°54.75'S, 168°40.66'E, 650-691 m, 29.09.1994: 1 specimen (MNHN 1997-720). — Stn CP 1035, 17°56.02'S, 168°44.06'E, 765-780 m, 29.09.1994: 1 specimen (MNHN 1997-723). — Stn CP 1049, 16°39.43'S, 168°02.97'E, 469-525 m, 1.10.1994: 1 specimen (MNHN 1995-985). — Stn CP 1050, 16°39.20'S, 168°01.30'E, 541-577 m, 1.10.1994: 1 specimen (MNHN 1995-961). — Stn CP 1052, 16°32.37'S, 168°00.29'E, 561-564 m, 1.10.1993: 3 specimens (MNHN 1995-905). — Stn CP 1053, 16°29.3'S, 167°58.70'E, 536-519 m, 1.10.1994: 1 specimen (MNHN 1995-868). — Stn CP 1054, 16°27.95'S, 167°57.44'E, 522-527 m: 1 specimen (MNHN 1995-848), 1 specimen (MNHN 1995-983). — Stn CP 1055, 16°30.11'S, 167°55.13'E, 572-580 m, 1.10.1994: 1 specimen (MNHN 1995-871). — Stn CC 1056, 16°33.11'S, 167°55.64'E, 602-620 m, 1.10.1994: 4 specimens (MNHN 1995-842). — Stn CP 1080, 15°57.30'S, 167°27.73'E, 799-850 m, 5.10.1994: 1 specimen 64.6 mm HL, 300+ mm TL (MNHN 1995-886). — Stn CP 1124, 15°01.7'S, 166°56.51'E, 532-599 m, 9.10.1994: 6 specimens (MNHN 1995-843).

New Caledonia. MUSORSTOM 7: stn CP 623, 12°34.02'S, 178°15'W, 1300-1280 m, 28.05.1992:1 specimen (MNHN 1997-713).

BATHUS 1: stn CP 657, 21°14.45'S, 165°54.93'E, 490-530 m, 12.03.1993: 1 specimen (MNHN 1995-819). — Stn CP 660, 21°10.48'S, 165°53.19'E, 786-800 m, 13.03.1993: 2 specimens (MNHN 1995-821). — Stn CP 671, 20°51.18'S, 165°28.17'E, 450-470 m, 14.03.1993: 6 specimens (MNHN 1995-814). — Stn CP 702, 20°55.97'S, 165°34.67'E, 591-660 m, 18.03.1993: 5 specimens (MNHN 1995-818). — Stn CP 708, 21°43.05'S, 166°38.57'E, 550-580 m, 19.03.1993: 1 specimen (MNHN 1995-822).

Norfolk Ridge. HALIPRO 2: stn BT 2, 23°17.54'S, 167°51.36'E, 1025-1049 m, 5.11.1996: 1 specimen 72 mm HL 385 mm TL (CAS 90617), 1 specimen 70 mm HL (CAS 90689). — Stn BT 73, 24°52.96'S, 167°37.41'E, 1043-1102 m, 20.11.1996: 1 specimen 63 mm HL 315+ mm TL (MNHN 1998-247). — Stn BT 76, 24°05.43'S, 167°34.29'E, 936-940 m, 21.11.1996: 2 specimens 62-79 mm HL, 340-415+ mm TL (CAS 90684). — Stn BT 90, 23°16.98'S, 168°08.38'E, 975-987 m, 23.11.1996: 1 specimen 78 mm HL, 380+ mm TL (BMNH 1997.5.21.37).

Loyalty Ridge. HALIPRO 2: stn BT 17, 24°34.35'S, 170°11.45'E, 935-936 m, 8.11.1996: 2 specimens 76-76 mm HL, 325+-375+ mm HL (MNHN 1998-319). — Stn BT 18, 24°34.42'S, 170°12.62'E, 946-988 m, 9.11.1996: 1 specimen (NMNZ P.34258).

REMARKS. — This newly described species was surprisingly abundant in these current collections, but not well represented in previous ones reported in IWAMOTO & MERRETT (1997). It was captured on 15 occasions off Vanuatu, six times off New Caledonia, four times off Norfolk Ridge, and twice off the Loyalty Ridge.

Source : MNHN, Paris

Ventrifossa vinolenta Iwamoto & Merrett, 1997

No representative of this species was found in current collections.

Subfamily MACROUROIDINAE

Genus ***SQUALOGADUS*** Gilbert & Hubbs, 1916

Squalogadus modificatus Gilbert & Hubbs, 1916

Fig. 29

Squalogadus modificatus - IWAMOTO & MERRETT, 1997: 482-483, Fig. 5 (New Caledonia; note that the station numbers have been confused in the Material Examined: MNHN 1994-928 is from Stn CP 72, MNHN 1994-927 is from Stn CP 60).

MATERIAL EXAMINED. — 15 specimens.

Norfolk Ridge. HALIPRO 2: stn BT 32, 25°19.93'S, 168°56.56'E, 697-1340 m, 12.11.1996: 1 specimen 105 mm HL, 340+ mm TL (CAS 90746). — Stn BT 33, 25°19.30'S, 168°57.56'E, 699-1280 m, 14.11.1996: 1 specimen (NMNZ P.34254). — Stn BT 41, 25°47.77'S, 167°11.52'E, 1317-1383 m, 14.11.1996: 1 specimen 110 mm HL, 325+ mm TL (BMNH 1997.5.21.23). — Stn BT 47, 25°38.43'S, 167°38.36'E, 1441-1467 m, 15.11.1996: 2 specimens, 49-70 mm HL, 135+-195+ mm TL (BMNH 1997.5.21:3-4). — Stn BT 67, 24°46.21'S, 168°14.99'E, 978-1330 m, 19.11.1996: 2 specimens 70-80 mm HL, 220+-250+ mm TL (BMNH 1997.5.21:5-6).

Loyalty Ridge. HALIPRO 2: stn BT 16, 24°33.85'S, 170°06.47'E, 1019-1200 m, 8.11.1996: 1 specimen 107 mm HL, 280+ mm TL (MNHN 1998-242). — Stn BT 23, 25°04.95'S, 170°11.7'E, 1105-1360 m, 10.11.1996: 1 specimen (MNHN 1998-250). — Stn BT 25, 25°16.64'S, 170°23.69'E, 1100-1348 m, 11.11.1996: 1 specimen 128 mm HL, 360+ mm TL (BMNH 1997.5.21.72), 2 specimens 115-125 mm HL, 330+-342+ mm TL (CAS 90618), 3 specimens (NMNZ P.34069).

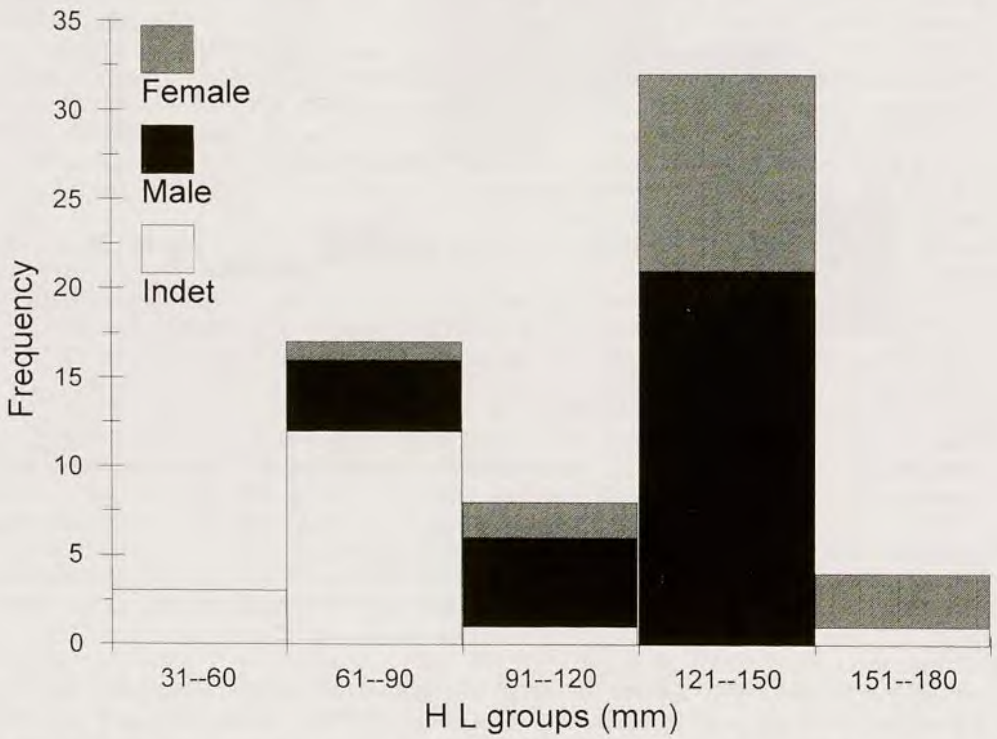

FIG. 29. — Length-frequency (HL, head length mm) distribution of *Squalogadus modificatus* by sex (n = 64).

Source : MNHN, Paris

REMARKS. — *Squalogadus modificatus* was captured in 29 trawls during the HALIPRO 2 cruise; four of those trawls were on the Loyalty Ridge, 19 on the Norfolk Ridge, and five on the Lord Howe Rise, in depths ranging from 697 to 1520 m. Although most captures ranged between one and eight adult specimens, on one occasion 79 specimens were collected. In contrast, the species was taken only twice during all previous ORSTOM cruises, and those captures consisted of two small juveniles. This is an obvious testimony to the effectiveness of large trawls with high mouth openings, such as used on the RV "*Tangaroa*", in capturing species that probably hover well above bottom and thus evade smaller nets that fish tightly on the bottom. *Squalogadus modificatus* is probably distributed throughout the New Caledonian region. On a worldwide basis, it is found almost circumtropically (excluding the Pacific coasts of the Americas).

Squalogadus modificatus from the HALIPRO 2 cruise suggested a bimodal length frequency distribution with females attaining the larger adult sizes (Fig. 29).

ACKNOWLEDGMENTS

We echo here our gratitude expressed earlier (IWAMOTO & MERRETT, 1997) to a wide variety of people and organizations who assisted us throughout the complete project. Pivotal in this help was Bernard SÉRET and his colleagues at the MNHN, who made the material available to us and provided generous hospitality during visits to Paris to examine the material. We thank the NATO International Scientific Exchange Programmes for their continued support from Collaborative Research Grant (no. 940670) that enabled us to travel to the institutions at which the material was housed. Bernard SÉRET also arranged for us, among others, to participate in the HALIPRO 2 survey of the RV "*Tangaroa*", which was funded by the ZoNeCo programme of evaluation of the marine resources of the economic zone of New Caledonia. We therefore also wish to thank the cruise leader, René GRANDPERRIN, and all the partners of that programmme. Moreover, the captain, scientific complement and crew of the "*Tangaroa*" made our participation both most productive and enjoyable and none more so than the NIWA representatives on the cruise, Malcolm CLARK and Dianne TRACEY. We thank them all.

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Finally we thank Alison E. SCHROEER for drawing Fig. 22 of *Kumba musorstom*.

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Source : MNHN, Paris

Source : MNHN, Paris

15

Pisces Pleuronectiformes: Flatfishes from New Caledonia and adjacent waters. Genus *Arnoglossus*

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ABSTRACT

Species of the bothid genus *Arnoglossus* collected from waters around New Caledonia are reviewed. Seven species, including two new species, two new zoogeographical records and three species already recorded from the region were identified, being *Arnoglossus septemventralis* sp. nov. and *A. nigrifrons* sp. nov., *A. tenuis*, *A. elongatus*, and *A. macrolophus*, *A. japonicus* and *A. polyspilus*, respectively. *Arnoglossus septemventralis* sp. nov., described from ten specimens collected between 230-315 m off southern New Caledonia, is easily separable from all other members of the genus in having seven pelvic rays on both sides. *Arnoglossus nigrifrons* sp. nov., described from two specimens collected from 300-315 m on the Chesterfield Plateau and northwest of New Caledonia, is characterized by a rounded upper head profile, several anterior dorsal fin rays elongated in males, gill rakers without serrations and a darkened head region. *Arnoglossus tenuis*, collected from 10-16 m off New Caledonia, was previously known from southern Japan to the South China Sea, and *A. elongatus*, from 250-350 m off New Caledonia, previously only from the Madura Sea and northwestern Australia. *Arnoglossus macrolophus* was collected from relatively shallow waters (49-92 m) off New Caledonia, and *A. japonicus* and *A. polyspilus* from deeper waters (210-385 m) off New Caledonia, the Loyalty Islands and Chesterfield Plateau.

AMAOKA, K. & MIHARA, E., 2000. — Pisces Pleuronectiformes: Flatfishes from New Caledonia and adjacent waters. - Genus *Arnoglossus*. *In*: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 21. *Mémoires du Muséum national d'Histoire naturelle*, **184**: 783-813. ISBN-2-85653-526-7.

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Source : MNHN, Paris

RÉSUMÉ

Pisces Pleuronectiformes : Poissons plats de la Nouvelle-Calédonie et des eaux avoisinantes. - Genre *Arnoglossus*.

Les espèces du genre *Arnoglossus* de la famille Bothidae, récoltées autour de la Nouvelle-Calédonie, sont étudiées. Sept espèces dont deux sont nouvelles (*Arnoglossus septemventralis* sp. nov. and *A. nigrifrons* sp. nov.), trois sont mentionnées pour la première fois de la région (*A. tenuis*, *A. elongatus* et *A. macrolophus*) et trois étaient déjà connues de la région (*A. macrolophus, A. japonicus* et *A. polyspilus*), ont été identifiées. *Arnoglossus septemventralis* sp. nov., décrit d'après 10 exemplaires récoltés entre 230 et 315 m de profondeur au sud de la Nouvelle-Calédonie, se distingue aisément de toutes les autres espèces du genre par la présence de 7 rayons pelviens sur chacune de ses faces. *Arnoglossus nigrifrons* sp. nov., décrit d'après deux spécimens récoltés entre 300 et 315 m sur le plateau des îles Chesterfield, au nord-est de la Nouvelle-Calédonie, se caractérise par une tête à profil supérieur bombé, plusieurs rayons antérieurs de la dorsale allongés chez les mâles, des arcs branchiaux non dentelés et des zones sombres sur la tête. *Arnoglossus tenuis*, récolté par 10-16 m de profondeur au large de la Nouvelle-Calédonie, n'était auparavant connu que du Japon du Sud à la mer de Chine méridionale et *A. elongatus*, récolté entre 250 et 350 m, que de la mer de Madura et du nord-ouest de l'Australie. *Arnoglossus macrolophus* a été récolté dans des eaux relativement peu profondes (49-92 m) au large de la Nouvelle-Calédonie, tandis que *A. japonicus* et *A. polyspilus* ont été trouvés dans des eaux plus profondes (210-385 m) au large de la Nouvelle-Calédonie, des îles Loyauté et sur le plateau des îles Chesterfield.

INTRODUCTION

Members of the genus *Arnoglossus* are characterized by an elliptical body, eyes separated by a ridge or extremely narrow concave space without any sexual dimorphism, no rostral or orbital spines, cycloid or feebly ctenoid scales on the ocular side of the body, and the caudal skeleton with four undivided plates. At least 37 nominal species are known from shallow to deep waters of the Indian, Pacific and Atlantic Oceans, except off the east coast of North and South America, and in the Mediterranean Sea.

In a revisional study of New Caledonian flatfishes, seven species of *Arnoglossus* from coastal to deeper waters were found. They included two new species, *A. septemventralis* sp. nov. and *A. nigrifrons* sp. nov., and two new zoogeographical records, *A. tenuis* and *A. elongatus.* The remaining three species, *A. macrolophus* (as *A. tapeinosoma*), *A. polyspilus* and *A. japonicus* were listed from the region by RIVATON (1989), RIVATON & RICHER DE FORGES (1990), and KULBICKI, RANDALL & RIVATON (1994).

In this paper descriptions and comments are given for each species, and an identification key provided for all of them.

MATERIALS AND METHODS

Information on the cruises where the samples studied here were collected can be found in:

— RICHER DE FORGES, CHEVILLON, LABOUTE, MENOU & TIRARD (1988) for CORAIL 2;
— RICHER DE FORGES (1990) for CHALCAL 1 and 2, MUSORSTOM 4, 5 and 6, SMIB 1 and 4;
— RICHER DE FORGES (1991) for LAGON;
— LEHODEY, RICHER DE FORGES, NAUGES, GRANDPERRIN, RIVATON (1992) for BERYX 11;
— RICHER DE FORGES (1993) for SMIB 5 and 6;
— RICHER DE FORGES & CHEVILLON (1996) for BATHUS 1 and HALIPRO 1.

Specimens were deposited in the Muséum national d'Histoire naturelle (MNHN), Paris, Laboratory of Marine Zoology, Faculty of Fisheries, Hokkaido University (HUMZ) and National Museum of New Zealand (NMNZ). Specimens were fixed in 10 % formalin and preserved in 75 % ethanol. Abbreviations for other institutions follow LEVITON *et al.* (1985).

Methods for measurements followed AMAOKA, MIHARA & RIVATON (1993). Gill rakers were counted as upper limb + lower limb. Vertebrae were counted as abdominal vertebrae + caudal vertebrae.

Source : MNHN, Paris

In the lists of material examined, the capital letters preceding the station number refer to the gear used: DC: Charcot dredge; DW: Warén dredge, CP: beam trawl; CC: shrimp otter trawl; BT: benthic fish trawl.

SYSTEMATIC ACCOUNT

Genus ***ARNOGLOSSUS*** Bleeker, 1862

Arnoglossus Bleeker, 1862: 427 (type species by original designation, *Pleuronectes arnoglossus* Schneider, 1801).
Anticitharus Günther, 1880: 47 (type species by original designation, *Anticitharus polyspilus* Günther, 1880).
Caulopsetta Gill, 1893: 124 [type species by original designation, *Pleuronectes scaphus* (Forster) Schneider, 1801].
Scidorhombus Tanaka, 1915: 567 (type species by original designation, *Scidorhombus pallidus* Tanaka, 1915).

DIAGNOSIS. — Body elliptical. Rostral and orbital spines absent. Interorbital space with narrow bony ridge or narrowly concave in both sexes. Mouth moderate or rather large in size, upper jaw length about 2.1-2.9 in head length. Dentition more or less equally developed on either side. Scales ctenoid with short ctenii or cycloid on ocular side. Lateral line developed only on ocular side. Pelvic fin on ocular side originating near tip of isthmus; base on ocular side longer than that on blind side. Four caudal plates (i.e., parhypural, hypurals, and hypural + epural) not splitted distally.

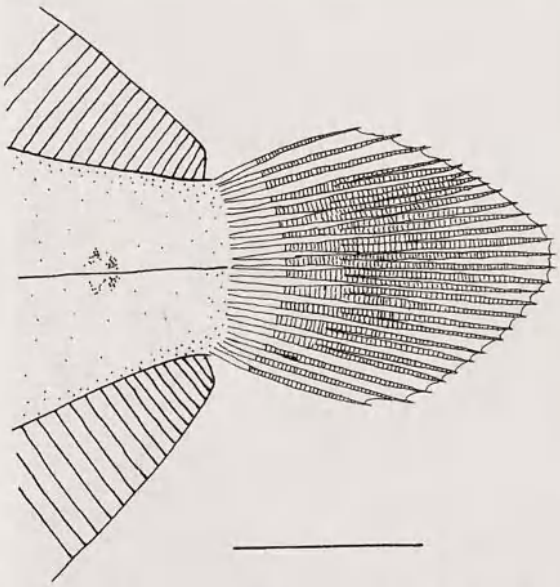

FIG. 1. — Diagrammatic illustration of caudal-fin type with bifurcated rays. Scale bar = 10 mm. Another type with rays branched into more than two is shown in Fig. 2.

REMARKS. — In most of the above characters, *Arnoglossus* closely resembles *Psettina*. However, *Psettina* has ctenoid scales on the ocular side with slender, long ctenii (vs. scales with short ctenii or cycloid) and a relatively small mouth, more than 2.7 in head length (vs. less than 2.9).

COMPARATIVE MATERIAL EXAMINED. — *Arnoglossus oxyrhynchus*: FAKU 33193-33198, 33208-33212, holotype and paratypes, 6 males and 5 females, 150.3-194.1 mm SL, Mimase, Kochi Pref., 10 December 1958; FAKU 33726, paratype, female, 186.9 mm SL, Mimase, 7 December 1959.

A. polyspilus: BMNH 1879.5.14:56, syntype, female, 190.0 mm SL, Kei Island, 236 m.

A. elongatus: BMNH 1930.10.16.1, syntype, male, 75.0 mm SL, 7°02.6'S, 115°23.6'E, Madura Sea, 100 m.

A. yamanakai: NSMT P.45060, 45063, male and female, 111.7-118.8 mm SL, 28°57.6'N, 124°06.0'E, East China Sea, 82 m, trawl, 30 October 1986, R.V. *"Yoko-maru"*, NSMT P.45062, female, 120.9 mm SL, 28°56.5'N, 124°52.9'E, East China Sea, 90 m, trawl, 30 October 1986, R.V. *"Yoko-maru"*, NSMT P.45070, male, 104.5 mm SL, 29°13.3'N, 124°14.6'E, East China Sea, 74 m, trawl, 22 October 1986, R.V. *"Yoko-maru"*.

Key to New Caledonian species of *Arnoglossus*

A1. Pelvic fin rays 7..... ***A. septemventralis*** sp. nov.

A2. Pelvic fin rays 6.

Source : MNHN, Paris

B1. Anterior dorsal fin rays greatly elongated, length of elongated fin rays greater than head length (Fig. 8). Dorsal and anal fins with a large dark spot posteriorly at base (Fig. 7) .. .. ***A. macrolophus*** Alcock, 1889

B2. Anterior dorsal fin rays not or only moderately elongated, length of anterior fin rays less than head length. Dorsal and anal fin bases without distinct spot posteriorly.

C1. Middle caudal fin rays bifurcated (Fig. 1).

D1. Scales almost always cycloid on ocular side. Some anterior teeth of upper jaw enlarged and widely spaced. Only second dorsal fin ray elongated in males .... ***A. japonicus*** Hubbs, 1915

D2. Scales almost always ctenoid on ocular side. Teeth of upper jaw gradually becoming larger and more widely spaced anteriorly. Second to third or fourth dorsal fin rays elongated in both sexes (Fig. 13) ..... ***A. elongatus*** Weber, 1913

C2. Middle caudal fin rays with more than two branches.

E1. Dorsal fin rays less than 94. Anal fin rays less than 71. Scales in lateral line less than 59 ..... ***A. tenuis*** Günther, 1880

E2. Dorsal fin rays more than 100. Anal fin rays more than 80. Scales in lateral line more than 70.

F1. Gill rakers serrated on each margin. Anterior head margin, snout and chin regions pale brownish ..... ***A. polyspilus*** (Günther, 1880)

F2. Gill rakers not serrated. Anterior head margin, snout and chin regions conspicuously darkened (Figs 17-18) ..... ***A. nigrifrons*** sp. nov.

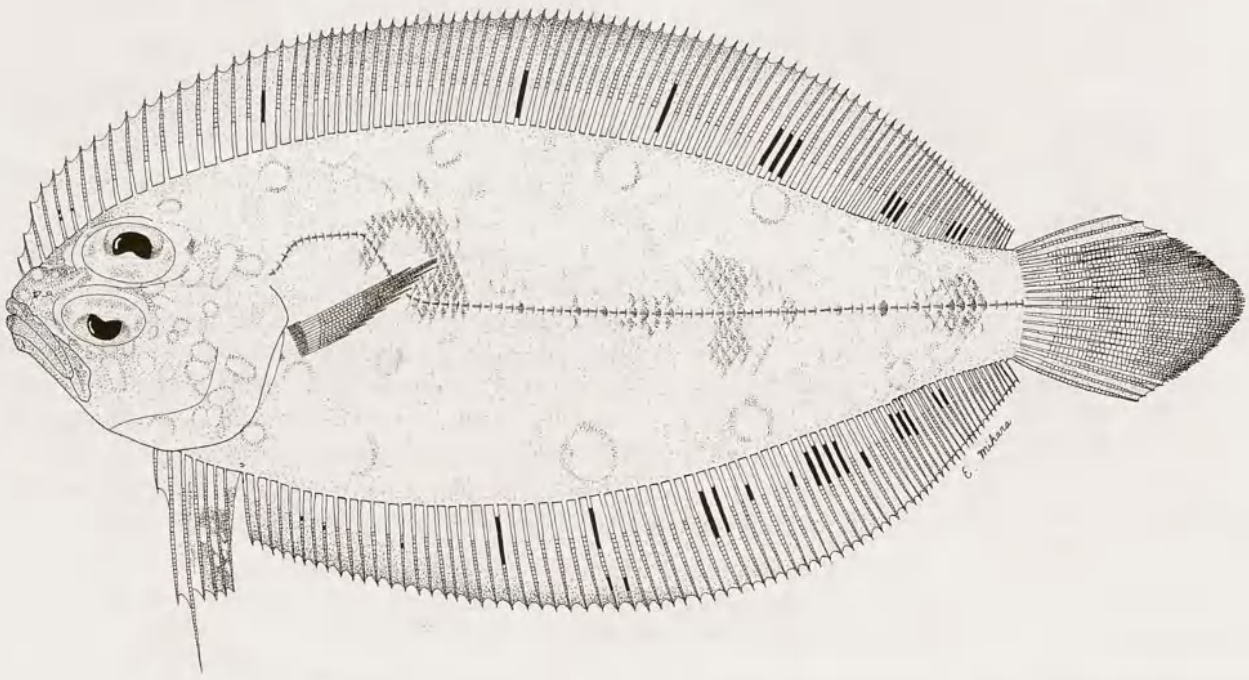

FIG. 2. — Illustration of *Arnoglossus septemventralis* sp. nov., holotype, male, 86.0 mm SL, from off southern New Caledonia (NMNZ P. 29090).

Source : MNHN, Paris

Arnoglossus septemventralis sp. nov.

Figs 2-6; Tables 1-2

MATERIAL EXAMINED. — 10 specimens (4 males and 6 females).

New Caledonia. CHALCAL 2: stn CP 26, 23°18.15'S, 168°03.58'E, 296 m, 31.10.1986: 1 ♂, paratype, 69.8 mm SL (HUMZ 142680); 2 ♂ and 1 ♀, paratypes, 56.8-69.8 mm SL (MNHN 1995-1171 to 1173). — Stn CP 27, 23°15.29'S, 168°04.55'E, 289 m, 31.10.1986: 1 ♀, paratype, 90.0 mm SL (HUMZ 142679); 1 ♀, paratype, 85.1 mm SL (MNHN 1995-1170).

SMIB 5: stn DW 103, 23°17.4'S, 168°04.8'E, 300-315 m, 14.09.1989: 1 ♀, paratype, 74.6 mm SL (MNHN 1995-1169).

BERYX 11: stn CP 16, 24°47.1'-46.9'S, 168°08.7'-08.8'E, 240-250 m, 16.10.1992: 1 ♂, holotype, 86.0 mm SL (NMNZ P.29090). — Stn CP 44, 23°41.3'-40.5'S, 168°00.6'-00.5'E, 230-250 m, 20.10.1992: 2 ♀, paratypes, 52.9-56.4 mm SL (NMNZ P.29046).

TYPES. — *Holotype*: NMNZ P.29090 (BERYX 11: stn 16, 24°47.1'-46.9'S, 168°08.7'-08.8'E, 240-250 m).
Paratypes: All the other specimens cited above.

DIAGNOSIS. — Pelvic fins with 7 rays; body shallow, depth 2.66-2.93 in SL; gill rakers serrated (Fig. 4A); dorsal fin rays 95-97; anal fin rays 73-79; scales in lateral line 78-84.

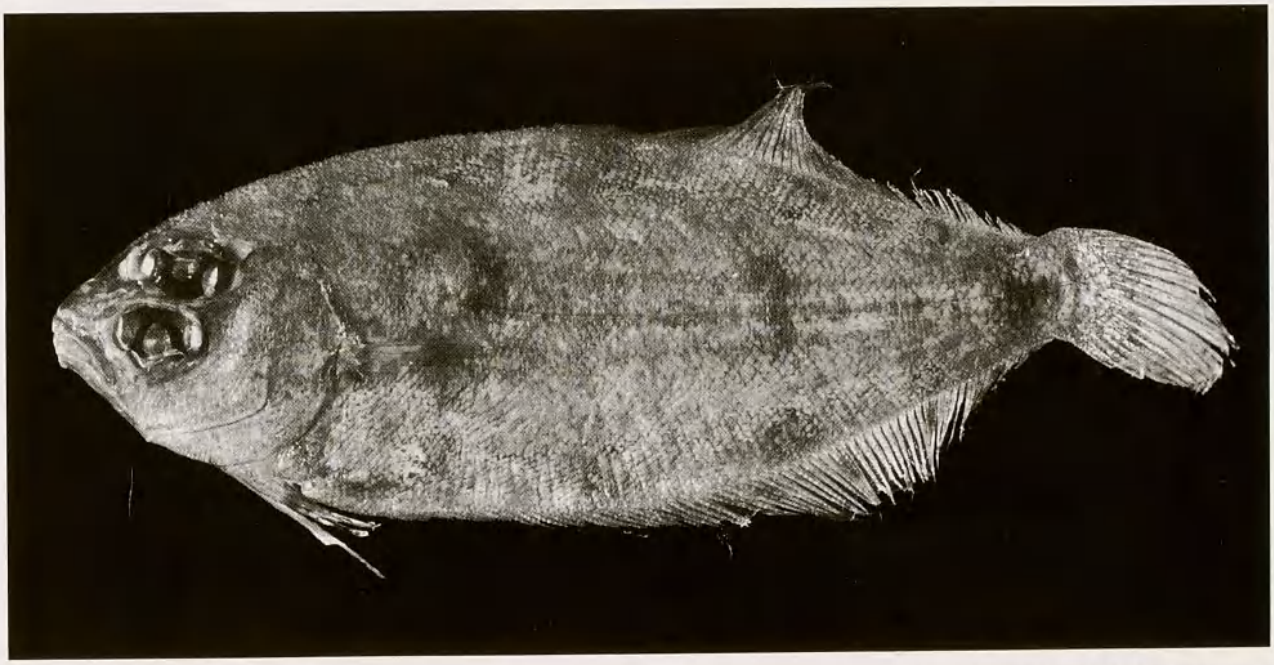

FIG. 3. — *Arnoglossus septemventralis* sp. nov., holotype, male, 86.0 mm SL, from off southern New Caledonia (NMNZ P.29090).

DESCRIPTION. — Data for holotype given first, followed in parentheses by ranges for paratypes and averages, including holotype, for proportional data. Counts and proportional measurements as percent of SL shown in Tables 1 and 2.

Head length 3.51 (3.41-3.78, 3.63) in SL; body depth 2.70 (2.66-2.93, 2.77). Snout length 4.80 (4.49-5.34, 4.84) in head length; upper eye diameter 3.10 (2.75-3.24, 2.97); lower eye diameter 3.14 (2.71-3.18, 2.99); interorbital width 49.00 (31.40-64.00, 46.82); upper jaw length 2.75 (2.53-2.92, 2.72) on ocular side, 2.63 (2.40-2.82, 2.61) on blind side; lower jaw length 2.04 (1.79-2.01, 1.95) on ocular side, 1.96 (1.69-1.90, 1.84) on blind side; depth of caudal peduncle 2.92 (2.70-3.08, 2.93); length of longest dorsal fin ray 2.36 (2.18-2.40, 2.30);

Source : MNHN, Paris

length of longest anal fin ray 2.19 (2.10-2.38, 2.20); pectoral fin length 1.78 (1.65-1.83, 1.74) on ocular side, 2.72 (2.85-3.25, 3.00) on blind side; pelvic fin length (except elongated ray) 1.96 (2.06-2.49, 2.14) on ocular side in males, (2.70-3.04, 2.84) in females, 2.75 (2.64-3.23, 2.96) on blind side; length of third pelvic fin ray 1.37 (1.79-2.23, 1.84) on ocular side in males, (3.00-3.25, 3.14) in females; length of pelvic fin base 4.02 (3.49-4.19, 3.83) on ocular side, 9.80 (7.68-9.69, 8.59) on blind side; length of middle caudal fin ray 1.30 (1.28-1.36, 1.33); lateral line curve width 2.21 (1.84-2.15, 2.03).

Body elongated, elliptical, deepest slightly anterior to midpoint; dorsal and ventral contours gently arched. Caudal peduncle depth 24.3-27.5 % of body depth. Head large; upper profile with a slight notch anterior to upper eye. Snout long, length 52.7-67.2 % of upper eye diameter. Rostral and orbital spines absent. Eyes large, separated by narrow bony ridge; upper eye diameter 81.5-103.8 % of upper jaw length on ocular side; lower eye in advance of upper. Ocular side nostrils anterior to dorsal margin of lower eye; anterior nostril tubular with a flap posteriorly; blind side nostrils small, near dorsal fin origin, similar in shape to those on ocular side.

Mouth large, oblique; maxilla extending posteroventrally to below anterior part of lower eye; anterior tip of lower jaw projecting slightly beyond tip of upper jaw when mouth closed. No distinct knob at mandibular symphysis. Dentition more or less equally developed on both jaws; teeth on upper jaw sharp, uniserial, becoming larger and more widely spaced anteriorly. Gill rakers on first arch moderate in size, dorsal margins serrated (Fig. 4A). Ocular side scales very small, with short ctenii (Fig. 4B); snout, anterior parts of both jaws, and interorbital region naked; cycloid scales on blind side. Lateral line curved above pectoral fin on ocular side; lateral line absent on blind side.

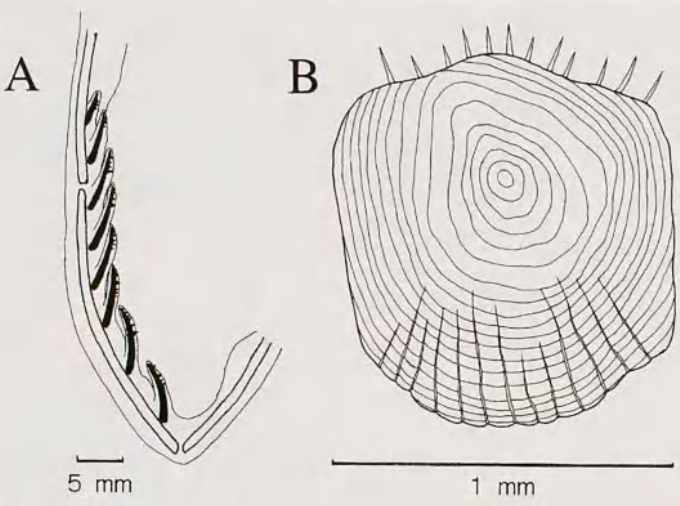

FIG. 4. — First gill arch (A) and a scale (B) from ocular side of *Arnoglossus septemventralis* sp. nov., paratypes, females (A: 90.0 mm SL, HUMZ 142679; B: 74.6 mm SL, MNHN 1995-1169).

Dorsal fin origin on blind side, anterior to interorbital region. Anal fin origin at a point equal with vertical through posterior margin of head. Pectoral fins unequal; length on ocular side 1.53-1.84 times that on blind side, much less than head length. Pelvic fins with 7 rays; origin of ocular side fin slightly posterior to tip of isthmus; third ray of ocular side fin in male elongated, longer than adjacent rays; that in female subequal to adjacent rays (Figs 5-6); pelvic fin base on ocular side longer than that on blind side, space between fourth and fifth ray on ocular side opposite to first ray on blind side. Tip of isthmus posterior to and ventral to posterior margin of lower eye. All fin rays simple, except caudal fin rays. Caudal fin rays with more than two branches, except upper- and lowermost two simple rays.

Vent on blind side, immediately dorsal to first anal fin ray. Urogenital papilla on ocular side, opposite side of vent.

Coloration in alcohol: Ocular side ground color light brown; snout, both jaws, area in front of eyes and interorbital region darkened; a series of dark rings along dorsal and anal margins of body; a few obscure dark spots on lateral line. Blind side uniformly pale brown. Dorsal and anal fins with series of obscure dark blotches; ocular side pectoral fin with three dark cross bands; distal half of fifth to seventh rays of ocular side pelvic fin darkened.

Sexual dimorphism: This species shows sexual dimorphism in length of the ocular side pelvic fin (Figs 5-6).

DISTRIBUTION. — All specimens were collected off southern New Caledonia, at depths between 230-315 m.

ETYMOLOGY. — Named for the seven pelvic fin rays, which constitute the singly most important diagnostic character of this species.

Source : MNHN, Paris

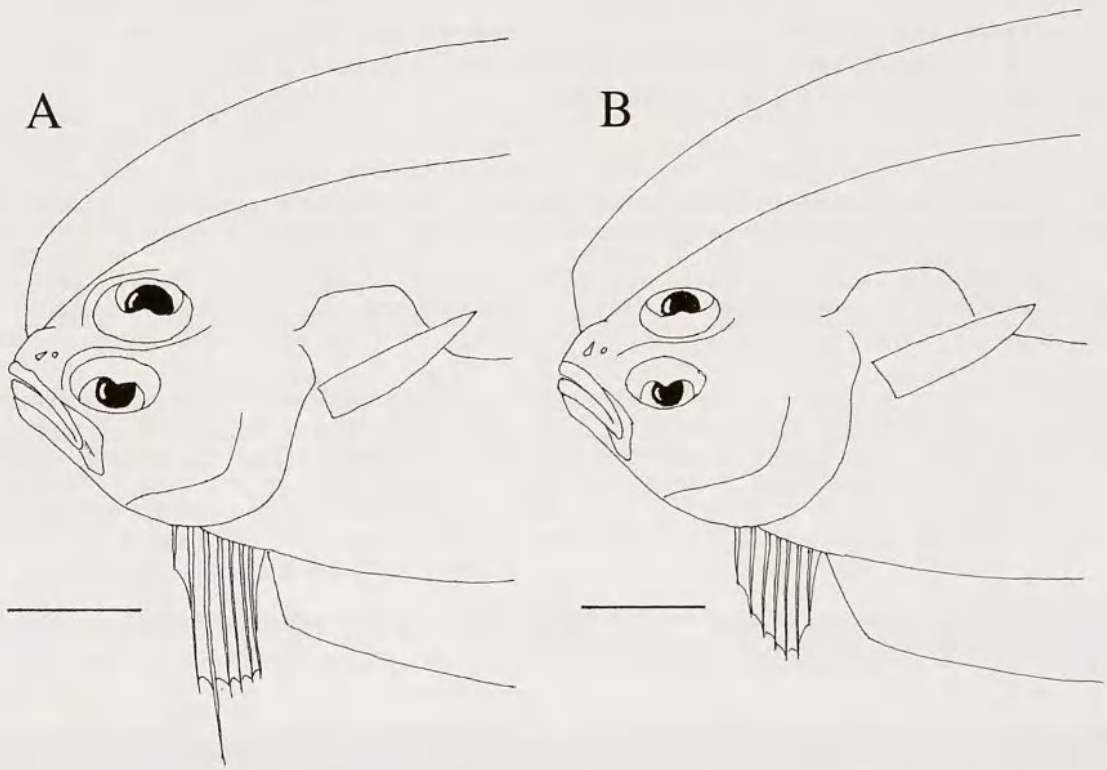

FIG. 5. — Diagrammatic illustration of anterior body parts showing sexual dimorphism in male (A) and female (B) of *Arnoglossus septemventralis* sp. nov. Scale bars = 10 mm.

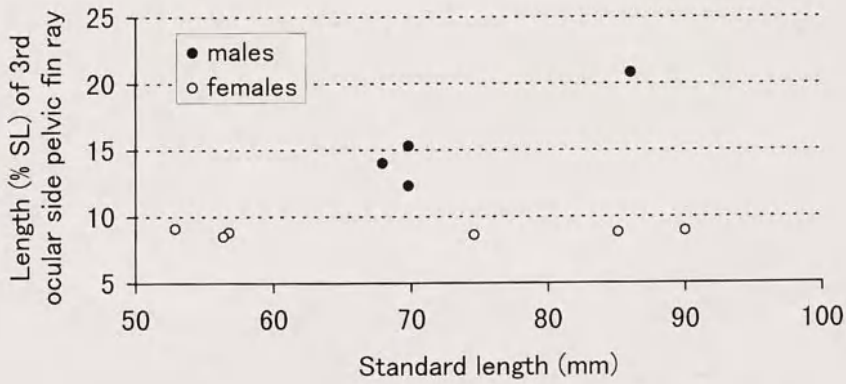

FIG. 6. — Relationship between SL and 3rd pelvic fin ray length on ocular side in percent of SL in *Arnoglossus septemventralis* sp. nov.

REMARKS. — *Arnoglossus septemventralis* sp. nov. is easily separable from all congeners by the presence of seven rays in the pelvic fin.

According to AMAOKA & IMAMURA (1990), the genus *Arnoglossus* can be divided into two groups of species, based on numbers of dorsal (less than vs. greater than 100) and anal fin rays (less than vs. greater than 80). *Arnoglossus septemventralis* belongs to the group with lower counts, thereby resembling *A. andrewsi* Kurth, 1954, *A. armstrongi* Scott, 1975 and *A. marisrubri* Klausewitz & Schneider, 1986, and also shares with the latter three species, a large number of lateral line scales. It differs from *A. andrewsi* and *A. armstrongi* in having a shallower body (2.66-2.93 in SL vs. 2.3-2.4 in *A. andrewsi*, 2.4 in *A. armstrongi*) and larger upper eye (2.75-3.24

Source : MNHN, Paris

in head length vs. 5.0-5.4, 4.2-4.9) (KURTH, 1954; SCOTT, 1975), and from *A. marisrubri* in having a lower number of gill rakers (8-9 on lower limb vs. 11-13 in *A. marisrubri*) and serrated gill rakers (vs. not serrated) (KLAUSEWITZ & SCHNEIDER, 1986). Furthermore, it differs from *A. andrewsi* in having a higher number of the ocular side pectoral fin rays (11-13 vs. 10) (KURTH, 1954).

TABLE 1. — Frequency distributions of selected meristic characters of *Arnoglossus septemventralis* sp. nov. Counts for holotype included in boldfaced numbers; counts from blind side shown in parentheses.

Dorsal fin rays			Anal fin rays							Caudal fin rays	Pectoral fin rays				
95	96	97	73	74	75	76	77	78	79	2+13+2	9	10	11	12	13
5	**2**	3	1	0	1	2	4	**1**	1	**1 0**	0(6)	0(**3**)	2(1)	**5**(0)	3(0)
Scales in lateral line										Gill rakers		Vertebrae			
78		79	80		81		82		83	84	0+8	0+9	10+30	10+31	10+32
1		0	0		4		2		2	**1**	5	**5**	1	6	**3**

TABLE 2. — Proportional measurements as percent of standard length in *Arnoglossus septemventralis* sp. nov. Averages include measurements from holotype. O, ocular side; B, blind side.

Character	Holotype ♂	Paratypes 3 ♂, 6 ♀	Average	SD
SL (mm)	86.0	52.9-90.0	70.9	13.1
Head length	28.5	26.4-29.3	27.6	0.8
Body depth	37.1	34.2-37.6	36.2	1.2
Snout length	5.9	5.3-6.0	5.7	0.2
Upper eye diameter	9.2	8.3-10.4	9.3	0.5
Lower eye diameter	9.1	8.7-10.2	9.2	0.5
Interorbital width	0.6	0.4-0.9	0.6	0.1
Upper jaw length (O)	10.3	9.6-10.7	10.1	0.3
Upper jaw length (B)	10.8	10.3-11.3	10.6	0.3
Lower jaw length (O)	14.0	13.4-14.9	14.2	0.5
Lower jaw length (B)	14.5	14.5-15.8	15.0	0.5
Caudal peduncle depth	9.8	8.9-10.0	9.4	0.3
Pectoral fin length (O)	16.0	14.9-17.8	15.8	0.8
Pectoral fin length (B)	10.5	8.4-9.6	9.2	0.6
Pelvic fin length (O, ♂)*	14.5	11.0-13.3	13.0	1.3
Pelvic fin length (O, ♀)		9.2-10.0	9.7	0.2
3rd pelvic ray length (O, ♂)	20.8	12.3-15.3	15.6	3.2
3rd pelvic ray length (O, ♀)		8.5-9.1	8.8	0.2
Pelvic fin length (B)	10.3	8.7-10.3	9.3	0.6
Pelvic fin base length (O)	7.1	6.7-7.9	7.2	0.3
Pelvic fin base length (B)	2.9	2.9-3.6	3.2	0.2
Longest dorsal fin ray	12.1	11.5-12.9	12.0	0.4
Longest anal fin ray	13.0	12.3-12.8	12.6	0.2
Middle caudal fin ray	21.9	19.5-21.2	20.6	0.7
Lateral line curve width	12.9	12.9-14.3	13.6	0.6

* except elongated third ray.

Source : MNHN, Paris

Arnoglossus macrolophus Alcock, 1889

Figs 7-9; Tables 3-4

Arnoglossus macrolophus Alcock, 1889: 280, pl. 18, fig. 2. — ALCOCK, 1890: 433; 1896: 327. — WEBER, 1913: 432. — NORMAN, 1927: 21, fig. 3. — FOWLER, 1928: 90. — ARAI & AMAOKA, 1996: 360, figs 1-4.

Bothus (Arnoglossus) tapeinosoma - WEBER & BEAUFORT, 1929: 127 (not *Platophrys (Arnoglossus) tapeinosoma* Bleeker, 1866).

Arnoglossus tapeinosoma - NORMAN, 1934: 185, fig. 131. — FOWLER, 1934: 63, fig. 18. — MUNRO, 1955: 260, pl. 49; 1958: 131, pl. 13. — BAOSHAN, 1962: 970, fig. 754. — ABRAHAM, 1963: 67. — MENON & YAZDANI, 1963: 157. — SHEN, 1966: 175, fig. 42a-b; 1983: 29, fig. 41. — DOR, 1970: 25, 1 fig. — AMAOKA, 1971: 28, pl. 3A. — WONGRATANA, 1975: 28. — KOTTHAUS, 1977: 5, fig. 434. — RIVATON & RICHER DE FORGES, 1990: 25, 60. — AMAOKA, OKAMURA & YOSHINO, 1992: 262, fig. 5.

MATERIAL EXAMINED. — 18 specimens (10 males and 8 females).

New Caledonia. LAGON: stn 610, 22°10.0'S, 166°58.0'E, 49 m, dredge, 5.08.1986: 1 ♀, 69.9 mm SL (MNHN 1995-1096). — Stn 742, 22°13.9'S, 167°02.8'E, 78 m, dredge, 13.08.1986: 1 ♀, 60.0 mm SL (MNHN 1995-1106). — Stn 833, 20°49.8'S, 165°17.7'E, 52-70 m, dredge, 11.01.1987: 6 ♂ and 3 ♀, 60.2-85.2 mm SL (MNHN 1995-1097 to 1105); 2 ♂ and 2 ♀, 65.2-82.3 mm SL (HUMZ 142653-142656).

BATHUS 1: stn CP 680, 20°48.03'S, 165°17.98'E, 86-92 m, 15.03.1993: ♂, 65.6 mm SL (MNHN 1995-1107); 1 ♂ and 1 ♀, 37.8-56.3 mm SL (HUMZ 142657-142658).

DIAGNOSIS. — Anterior dorsal fin rays greatly elongated in both sexes, first dorsal fin ray longer than head length in specimens greater than 60 mm SL (Fig. 8); dorsal and anal fins with a large dark spot posteriorly at base of fin rays (Fig. 7).

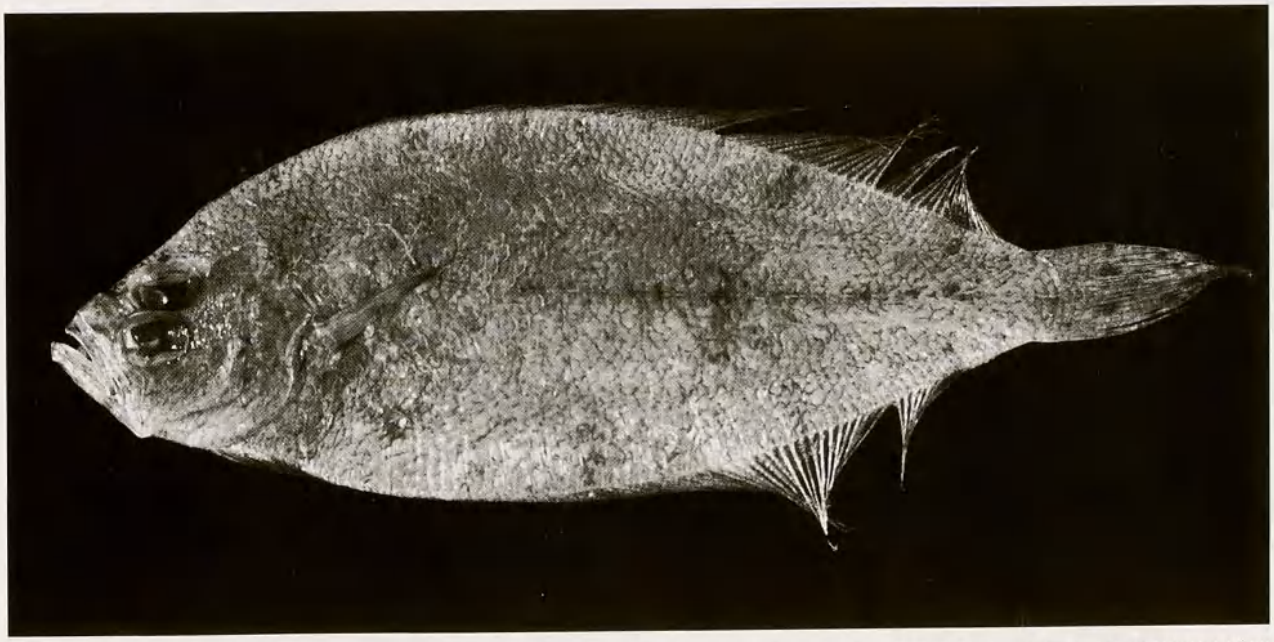

FIG. 7. — *Arnoglossus macrolophus* Alcock, 1889, male, 65.6 mm SL, from off northern New Caledonia (MNHN 1995-1107).

DESCRIPTION. — Ranges for proportional data given first, followed by averages. Counts and proportional measurements as percent of SL shown in Tables 3 and 4.

Head length 3.74-4.20, 3.98 in SL; body depth 2.43-2.78, 2.60. Snout length 3.65-4.33, 3.98 in head length; upper eye diameter 3.47-4.14, 3.79; lower eye diameter 3.32-4.14, 3.82; interorbital width 22.29-50.50, 32.66; upper jaw length 2.30-2.51, 2.41 on ocular side, 2.54-2.78, 2.68 on blind side; lower jaw length 1.75-1.94, 1.84 on ocular side, 1.90-2.06, 1.98 on blind side; depth of caudal peduncle 2.27-2.66, 2.47; length of first dorsal fin

Source : MNHN, Paris

ray 0.33-0.84, 0.59 in males, 0.77-1.61, 0.95 in females; length of longest dorsal fin ray except anterior elongated rays 1.68-1.96, 1.84; length of longest anal fin ray 1.64-1.95, 1.79; pectoral fin length 1.47-1.75, 1.62 on ocular side, 2.18-2.56, 2.35 on blind side; pelvic fin length 1.65-2.97, 2.10 on ocular side in males, 2.43-2.79, 2.58 in females, 2.29-3.06, 2.60 on blind side; length of pelvic fin base 3.24-4.04, 3.51 on ocular side, 7.13-9.57, 8.18 on blind side; length of middle caudal fin ray 1.18-1.33, 1.27; lateral line curve width 1.82-1.99, 1.89.

Body elongated, elliptical, deepest slightly anterior to midpoint. Caudal peduncle depth about 24.3-27.9 % of body depth. Head small; upper profile with a large notch anterior to upper eye. Snout moderate, length 87.8-107.8 % of upper eye diameter. Rostral and orbital spines absent. Eyes moderate, separated by narrow bony ridge, upper eye diameter 56.2-69.5 % of upper jaw length on ocular side; lower eye slightly in advance of upper. Ocular side nostrils anterior to dorsal margin of lower eye; anterior nostril tubular with a flap posteriorly; blind side nostrils small, near origin of dorsal fin, similar in shape to those on ocular side.

Mouth large, oblique; maxilla extending to below anterior part of lower eye; anterior tip of lower jaw projecting slightly beyond tip of upper jaw when mouth closed. Small ventrally directed knob at mandibular symphysis. Dentition more or less equally developed on jaws of both sides; teeth on upper jaw sharp, uniserial; lower jaw teeth uniserial, nearly similar to anterior teeth of upper jaw in size and spacing. Gill rakers on first arch slender, not serrated, absent on upper limb. Scales large, deciduous, with short ctenii on ocular side, cycloid on blind side. Lateral line curved above pectoral fin on ocular side; lateral line absent on blind side.

Dorsal fin origin on blind side, anterior to upper eye; anterior 3-5 rays greatly elongated in males, length 1.2-3.0 times head length, anterior 2-3 rays greatly elongated in females, length 0.6-1.3 times head length (Fig. 8). Anal fin origin at a point equal with vertical through posterior margin of head. Pectoral fins unequal, length of ocular side fin1.3-1.6 times that of blind side. Pelvic fins with 6 rays; ocular side pelvic fin rays longer in males than those in females (Figs 8-9); approximately fourth ray of ocular side fin opposite first ray of blind side fin. Tip of isthmus ventral to vertical through posterior margin of lower eye. Caudal fin rays with more than two branches, except upper- and lowermost two simple rays.

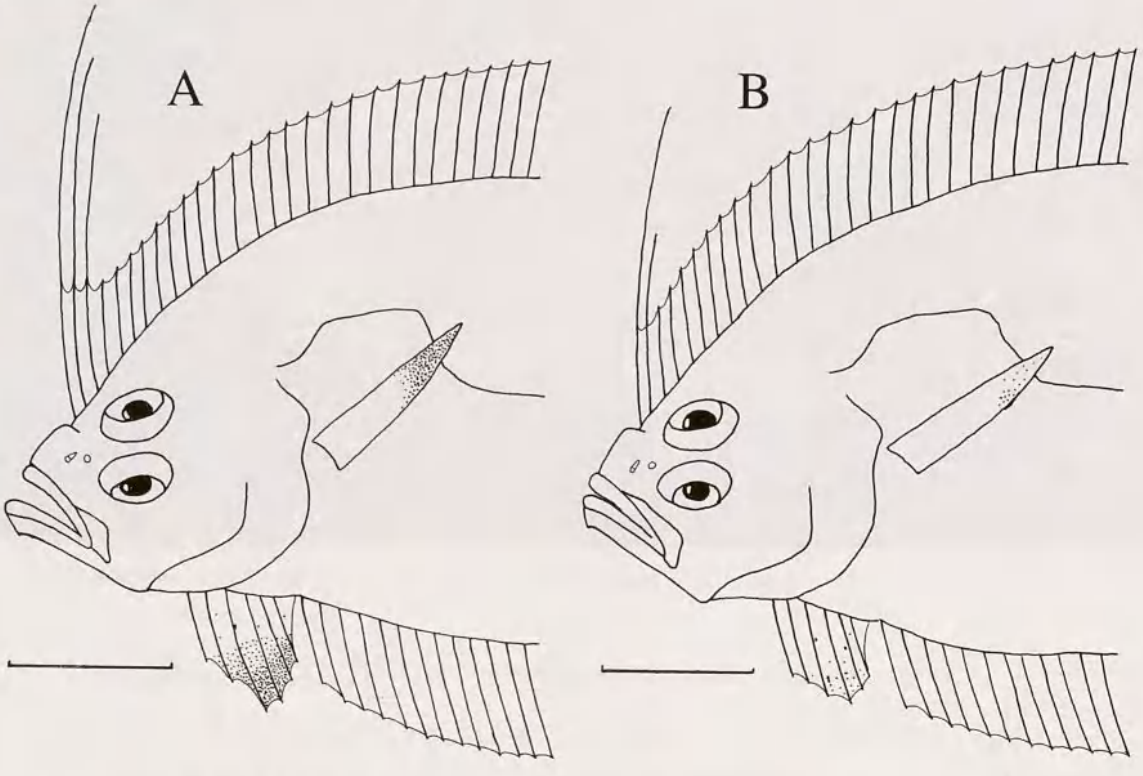

FIG. 8. — Diagrammatic illustration of anterior body parts showing sexual dimorphism in male (A) and female (B) of *Arnoglossus macrolophus*. Scale bars = 10 mm.

Source : MNHN, Paris

Vent on blind side, immediately dorsal to first anal fin ray; urogenital papilla on ocular side, opposite side of vent.

TABLE 3. — Frequency distributions of selected meristic characters of *Arnoglossus macrolophus*. Counts from blind side shown in parentheses.

Dorsal fin rays						Anal fin rays					Caudal fin rays		Pectoral fin rays						
91	92	93	94	95	96	70	71	72	73	74	2+13+2	2+11+4	8	9	10	11	12	13	14
1	4	**4**	2	5	2	2	2	7	6	1	17	1	0(1)	0(4)	0(10)	0(3)	7(0)	6(0)	5(0)

Scales in lateral line								Gill rakers				Vertebrae	
56	57	58	59	60	61	62	63	0+10	0+11	0+12	0+13	10+31	10+32
2	0	3	2	5	2	2	1	4	3	9	2	15	3

TABLE 4. — Proportional measurements as percent of standard length in *Arnoglossus macrolophus*. O, ocular side; B, blind side.

Character	Range 10 ♂, 8 ♀	Average	SD
SL (mm)	37.8-85.2	68.1	11.29
Head length	23.8-26.7	25.1	0.7
Body depth	36.0-41.2	38.6	1.3
Snout length	5.9-6.9	6.3	0.3
Upper eye diameter	5.9-7.5	6.7	0.4
Lower eye diameter	5.9-7.8	6.6	0.5
Interorbital width	0.5-1.2	0.8	0.1
Upper jaw length (O)	9.7-11.1	10.4	0.4
Upper jaw length (B)	8.7-10.3	9.4	0.4
Lower jaw length (O)	12.8-14.5	13.7	0.5
Lower jaw length (B)	12.0-13.5	12.7	0.5
Caudal peduncle depth	9.3-11.3	10.2	0.4
Pectoral fin length (O)	14.3-17.2	15.6	0.7
Pectoral fin length (B)	9.9-11.4	10.7	0.4
Pelvic fin length (O, ♂)	9.0-15.3	12.2	1.8
Pelvic fin length (O, ♀)	9.2-10.3	9.8	0.4
Pelvic fin length (B)	8.7-11.0	9.7	0.6
Pelvic fin base length (O)	6.6-8.0	7.2	0.5
Pelvic fin base length (B)	2.6-3.5	3.1	0.3
Longest dorsal fin ray*	12.8-14.4	13.7	0.5
Longest anal fin ray	12.8-15.4	14.1	0.6
Middle caudal fin ray	18.7-20.9	19.8	0.6
Lateral line curve width	12.0-14.2	13.3	0.6
First dorsal fin ray (♂)	29.5-74.9	46.7	15.5
First dorsal fin ray (♀)	15.8-31.8	27.7	4.7

* except anterior elongated rays.

Coloration in alcohol: Ocular side ground color dark brown; a few obscure dark blotches on lateral line; a series of blotches along dorsal and anal margins. Blind side uniformly pale brown. Dorsal and anal fins with series of dark spots basally and large dark spot at base posteriorly; ocular side pectoral fin and pelvic fin on both sides with

Source : MNHN, Paris

darker margins in males than females, pectoral and pelvic fins on ocular side with dark margins or spots in females (Figs 7-8); caudal fin with a pair of obscure blotches proximally and five blotches distally along posterior margin.

Sexual dimorphism: The specimens showed sexual dimorphism in lengths of the ocular side pelvic fin and the elongated anterior dorsal fin rays, the number of elongated dorsal fin rays and coloration of the pectoral and pelvic fins (Figs 8-9).

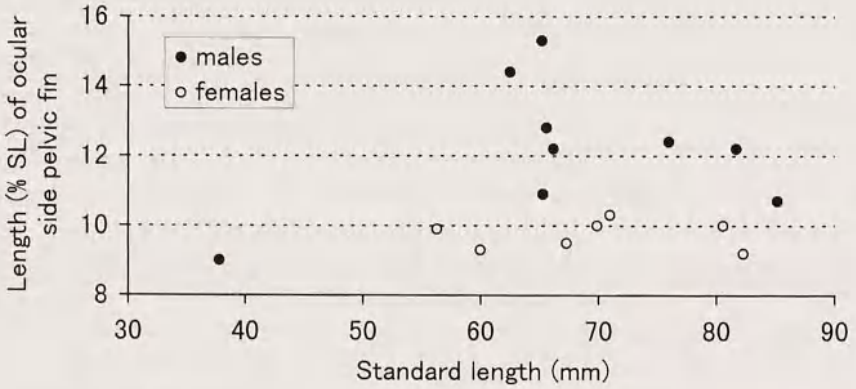

FIG. 9. — Relationship between SL and pelvic fin length on ocular side in percent of SL in *Arnoglossus macrolophus*.

DISTRIBUTION. — Widely distributed from the Red Sea (KOTTHAUS, 1977) and Persian Gulf (NORMAN, 1927), through the northern Indian Ocean (ALCOCK, 1889; ABRAHAM, 1963) and Malay Archipelago (WEBER, 1913) to southern Japan (AMAOKA, OKAMURA & YOSHINO, 1992) and New Caledonia (RIVATON & RICHER DE FORGES, 1990), in depths of 18-141 m.

REMARKS. — *Arnoglossus macrolophus* has two unique characters, the greatly elongated anterior dorsal fin rays and the large dark spots posteriorly on both the dorsal and anal fin bases. The species is easily separable from all other congeners by these two characters.

In *A. macrolophus*, the several anterior rays of the dorsal fin have been reported as greatly elongated in males, but only slightly longer than the other rays in females. However, those of New Caledonian specimens are greatly elongated and longer than the head length also in females. This is likely to represent geographical variation in this species, since other characters do not differ significantly from those of specimens collected elsewhere (AMAOKA, OKAMURA & YOSHINO, 1992; ARAI & AMAOKA, 1996).

Arnoglossus japonicus Hubbs, 1915

Fig. 10; Tables 5-6

Arnoglossus japonicus Hubbs, 1915: 454, pl. 25, fig. 2. — NORMAN, 1934: 192, fig. 139. — OKADA & MATSUBARA, 1938: 421, pl. 104, fig. 1. — KURODA, 1951: 389; 1962: 1. — BÖHLKE, 1953: 139. — MATSUBARA, 1955: 1258. — AMAOKA, 1969: 194, figs 78-79; 1973: 145, figs 1-7; 1984: 350, pl. 369-D. — SHEN, 1983: 30, fig. 42. — GLOERFELT-TARP & KAILOLA, 1984: 273, 358, 1 fig. — RIVATON, 1989: 155, 163. — NAKABO, 1993: 1173, 1 fig. — KULBICKI, RANDALL & RIVATON, 1994: 37.

Arnoglossus oxyrhynchus - RIVATON & RICHER DE FORGES: 1990: 25, 60 (not *Arnoglossus oxyrhynchus* Amaoka, 1969).

MATERIAL EXAMINED. — 29 specimens (11 males, 8 females and 10 juveniles).

New Caledonia. MUSORSTOM 4: stn CP 154, 19°02.60'S, 163°17.80'E, 275 m, 14.09.1985: 1 ♂ and 3 ♀, 80.1-105.8 mm SL (MNHN 1995-1150 to 1153).

BATHUS 1: stn CP 712, 21°44.26'S, 166°35.34'E, 210 m, 19.03.1993: 1 ♂, 97.9 mm SL (HUMZ 142671); 1 ♀, 106.0 mm SL (MNHN 1995-1154). — Stn CP 713, 21°45.28'S, 166°36.83'E, 250 m, 19.03.1993: 1 ♀, 106.0 mm SL (MNHN 1995-1155).

Loyalty Islands. MUSORSTOM 6: stn CP 419, Lifou Island, 20°41.65'S, 167°03.70'E, 283 m, 16.02.1989: 6 juveniles, 46.4-49.8 mm SL (MNHN 1995-1146 to 1149, HUMZ 142668-142669). — Stn CP 455, 21°00.65'S,

Source : MNHN, Paris

167°26.08'E, 260 m, 20.02.1989: 2 juveniles, 47.3-48.7 mm SL (MNHN 1995-1143 to 1144). — Stn DW 456, 21°00.71'S, 167°26.35'E, 225-240 m, 20.02.1989: 1 juvenile, 49.0 mm SL (MNHN 1995-1145).

Chesterfield Plateau. CHALCAL 1: stn CP 5, 19°29.10'S, 158°37.63'E, 290 m, 16.07.1984: 2 ♂, 101.8-125.5 mm SL (MNHN 1995-1133 to 1134). — Stn CP 10, 20°00.20'S, 158°46.60'E, 225 m, 22.07.1984: 2 ♂ and 1 ♀, 48.8-51.4 mm SL (MNHN 1995-1140 to 1142); 1 ♂ and 1 ♀, 50.9-51.9 mm SL (HUMZ 142666-142667). — Stn CP 11, 20°04.40'S, 158°47.41'E, 300 m, 22.07.1984: 3 ♂, 57.0-115.8 mm SL (MNHN 1995-1135 to 1137).

CORAIL 2: stn CP 131, 19°25.49'S, 158°37.96'E, 217 m, 29.07.1984: 1 ♂ and 1 juvenile, 45.3-58.9 mm SL (MNHN 1995-1138 to 1139).

MUSORSTOM 5: stn DW 350, 19°34.00'S, 158°35.30'E, 280 m, 17.10.1986: 1 ♀, 125.7 mm SL (HUMZ 142670).

DIAGNOSIS. — Middle caudal fin rays bifurcated (Fig. 1); ocular side scales mostly cycloid; some anterior teeth enlarged and widely spaced; second dorsal fin ray elongated in males; gill rakers serrated on dorsal margins.

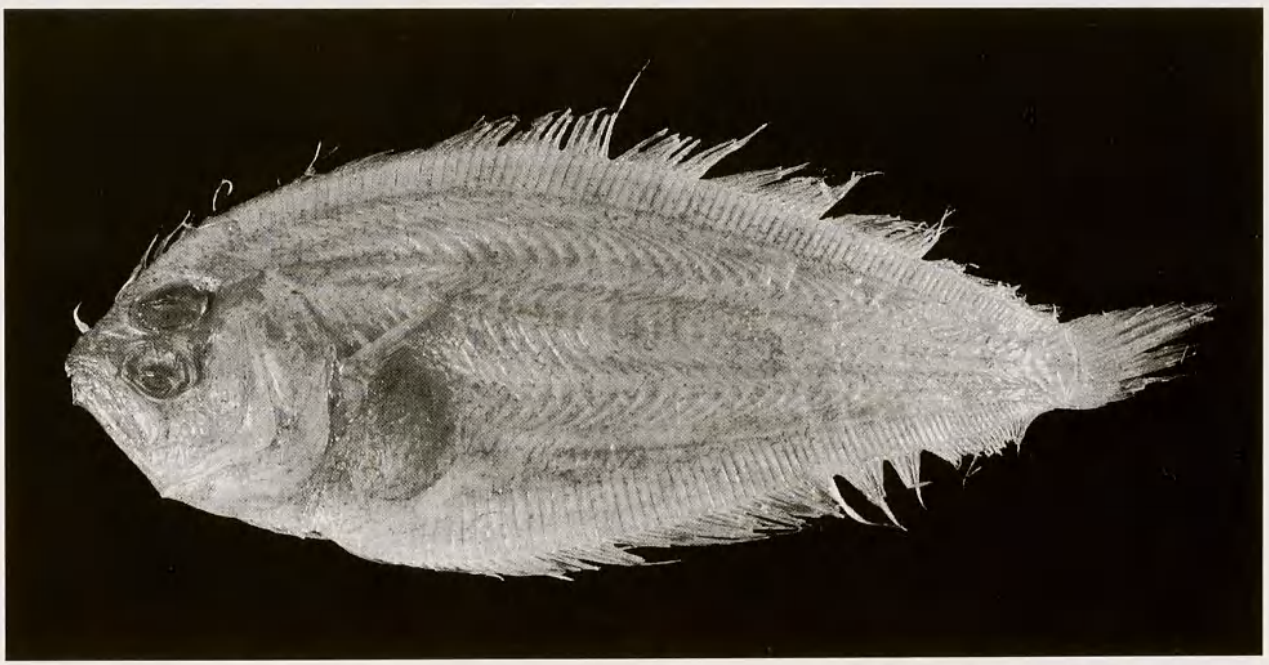

FIG. 10. — *Arnoglossus japonicus* Hubbs, 1915, female, 125.7 mm SL, from Chesterfield Plateau (HUMZ 142670).

DESCRIPTION. — Ranges for proportional data given first, followed by averages. Counts and proportional measurements as percent of SL shown in Tables 5 and 6.

Head length 3.39-4.11, 3.73 in SL; body depth 2.44-3.04, 2.74. Snout length 4.00-4.67, 4.38 in head length; upper eye diameter 3.39-4.21, 3.73; lower eye diameter 3.39-4.21, 3.70; interorbital width 25.70-119.00, 45.05; upper jaw length 2.11-2.80, 2.33 on ocular side, 1.79-2.73, 2.14 on blind side; lower jaw length 1.76-2.12, 1.89 on ocular side, 1.59-2.05, 1.74 on blind side; depth of caudal peduncle 2.77-3.76, 3.30; length of longest dorsal fin ray 1.78-2.20, 2.01; length of longest anal fin ray 1.75-2.20, 1.95; pectoral fin length 1.79-2.48, 2.02 on ocular side, 3.32-4.52, 3.88 on blind side; pelvic fin length 3.11-3.58, 3.35 on ocular side, 2.73-3.19, 2.97 on blind side; length of pelvic fin base 2.95-4.03, 3.41 on ocular side, 6.76-9.34, 8.04 on blind side; length of middle caudal fin ray 1.28-1.64, 1.46; lateral line curve width 2.28-2.63, 2.41.

Body elongated, elliptical, deepest slightly anterior to midpoint; dorsal and ventral contour gently arched. Caudal peduncle depth 20.0-25.9 % of body depth. Head large; a slight notch anterior to ventral margin of upper eye. Snout long, length 73.8-93.8 % of upper eye diameter. Rostral and orbital spines absent. Eyes moderate, separated by narrow bony ridge; upper eye diameter 56.0-72.7 % of upper jaw length on ocular side; lower eye in advance of upper. Ocular side nostrils anterior to dorsal margin of lower eye; anterior nostril tubular with a flap posteriorly; blind side nostrils small, ventral to origin of dorsal fin, similar in shape to those on ocular side.

Source : MNHN, Paris

Mouth large, oblique; maxilla extending to below middle part of lower eye; anterior tip of upper jaw projecting slightly beyond tip of lower jaw when mouth closed. Small ventrally directed knob at mandibular symphysis. Dentition more or less equally developed on both jaws; teeth on upper jaw sharp, uniserial, some anterior teeth enlarged and widely spaced; lower jaw teeth uniserial, nearly equal to anterior teeth of upper jaw in size and spacing. Gill rakers on first arch serrated, absent on upper limb. Scales large, deciduous, cycloid and weakly ctenoid with short ctenii on ocular side, cycloid on blind side. Lateral line curved above pectoral fin on ocular side; lateral line absent on blind side.

TABLE 5. — Frequency distributions of selected meristic characters of *Arnoglossus japonicus*. Counts from blind side shown in parentheses.

Dorsal fin rays							Anal fin rays							Pectoral fin rays					
103	104	105	106	107	108	109	81	82	83	84	85	86	87	9	10	11	12	13	14
1	3	8	7	3	3	3	2	6	5	12	3	0	1	0(2)	0(12)	0(13)	1(0)	19(0)	9(0)

Caudal fin rays		Scales in lateral line											Gill rakers				Vertebrae	
10 + 33	10 + 34	70	71	72	73	74	75	76	77	78	79	80	0+7	0+8	0+9	1+7	10+33	10+34
15	14	1	2	1	8	5	2	5	0	0	4	1	8	19	1	1	15	14

TABLE 6. — Proportional measurements as percent of standard length in *Arnoglossus japonicus*. O, ocular side; B, blind side; juv., juveniles.

Character	Range 11 ♂, 8 ♀, 10 juv.	Average	SD
SL (mm)	45.3-125.5	71.4	27.90
Head length	24.3-29.5	26.9	1.4
Body depth	32.9-41.1	36.6	2.0
Snout length	5.4-6.7	6.1	0.4
Upper eye diameter	6.2-8.6	7.2	0.7
Lower eye diameter	6.1-8.4	7.3	0.7
Interorbital width	0.2-1.0	0.7	0.2
Upper jaw length (O)	8.8-13.3	11.6	1.3
Upper jaw length (B)	9.0-15.0	12.7	1.6
Lower jaw length (O)	11.6-16.2	14.3	1.2
Lower jaw length (B)	12.0-17.8	15.5	1.6
Caudal peduncle depth	7.6-9.1	8.2	0.4
Pectoral fin length (O)	10.1-15.4	13.4	1.6
Pectoral fin length (B)	5.5-8.5	7.0	0.9
Pelvic fin length (O)	7.2-8.7	8.1	0.4
Pelvic fin length (B)	8.1-10.0	9.0	0.5
Pelvic fin base length (O)	7.1-8.7	7.9	0.4
Pelvic fin base length (B)	2.9-3.8	3.4	0.2
Longest dorsal fin ray	12.7-13.7	13.3	0.4
Longest anal fin ray	12.9-13.9	13.5	0.3
Middle caudal fin ray	16.2-19.3	18.0	0.9
Lateral line curve width	10.4-12.3	11.3	0.8

Dorsal fin origin on blind side, anterior to ventral margin of upper eye; second ray elongated more than adjacent rays in mature males, not elongated in females and juveniles. Anal fin origin at a point equal with vertical through basal part of pectoral fin. Pectoral fins unequal, length of ocular side fin 1.71-2.12 times that of blind side. Pelvic

Source : MNHN, Paris

fins with 6 rays; approximately fourth ray of ocular side fin opposite first ray of blind side fin. Tip of isthmus extending posterior to and ventral to lower eye. Caudal fin rays bifurcated except upper- and lowermost three simple rays.

Vent opens on blind side, immediately dorsal to origin of anal fin. Urogenital papillae on ocular side, opposite side of vent.

Coloration in alcohol: Ocular side ground color light brown. Blind side uniformly pale yellowish-white. Dorsal and anal fins with series of dark spots.

Sexual dimorphism: This species shows sexual dimorphism in length of the second dorsal fin ray.

DISTRIBUTION. — Distributed from the southern coast of Japan (HUBBS, 1915) to Taiwan (SHEN, 1983), the northwestern coast of Australia (GLOEFELT-TARP & KAILOLA, 1984) and the Coral Sea (RIVATON, 1989), in depths of 86-300 m.

REMARKS. — This species closely resembles *A. yamanakai* and *A. oxyrhynchus* in having an elongated second dorsal fin ray in males, gill rakers with serrated margins and bifurcated middle caudal fin rays. However, it differs from them in having mostly cycloid scales on the ocular side (vs. scales always feebly ctenoid). *Arnoglossus japonicus* further differs from *A. yamanakai* in having the dorsal fin with a series of dark spots (vs. dorsal fin with a black band along distal margin from posterior part of head to middle of body in males) (FUKUI, YAMADA & OZAWA, 1990) and from *A. oxyrhynchus* in having uniserial upper jaw teeth (vs. biserial on at least posterior half of blind side upper jaw), a lower number of lateral line scales (70-80 vs. 87-94), and the pectoral and pelvic fins without significant markings (vs. pectoral and pelvic fins with blackish markings).

This species has been reported as having cycloid scales on either side of the body. However, the present specimens have some weak ctenoid scales with short spinules in addition to cycloid scales on the ocular side.

Arnoglossus elongatus Weber, 1913

Figs 11-13; Tables 7-8

Arnoglossus elongatus Weber, 1913: 431, fig. 79. — NORMAN, 1934: 189, fig. 136. — GLOERFELT-TARP & KAILOLA, 1984: 273, 358, 1 fig.
Bothus (*Arnoglossus*) *elongatus*: WEBER & BEAUFORT, 1929: 125, fig. 29.

MATERIAL EXAMINED. — 6 specimens (5 males and 1 female).
New Caledonia. MUSORSTOM 4: stn CC 173, 19°02.50'S, 163°18.80'E, 250-290 m, 17.09.1985: 1 ♂, 98.8 mm SL (HUMZ 142676).
BATHUS 1: stn CP 669, 20°57.28'S, 165°35.30'E, 255-280 m, 14.03.1993: 3 ♂, 66.4-88.0 mm SL (MNHN 1995-1165 to 1167); 1 ♀, 84.5 mm SL (HUMZ 142677).
HALIPRO 1: stn CC 856, 21°43.08'S, 166°37.76'E, 350 m, 20.03.1994: 1 ♂, 96.1 mm SL (MNHN 1995-1164).

DIAGNOSIS. — Middle caudal fin rays bifurcated (Fig. 1); dorsal fin with a dark band on distal margin in males (Fig. 13); second and third, sometimes fourth dorsal fin rays elongated in both sexes (Fig. 13).

DESCRIPTION. — Ranges for proportional data given first, followed by averages. Counts and proportional measurements as percent of SL shown in Tables 7 and 8.

Head length 3.86-4.12, 3.95 in SL; body depth 2.67-3.15, 2.83. Snout length 4.27-5.09, 4.78 in head length; upper eye diameter 2.92-3.30, 3.11; lower eye diameter 2.92-3.25, 3.09; interorbital width 26.67-54.50, 40.01; upper jaw length 2.38-2.55, 2.45 on ocular side, 2.20-2.38, 2.28 on blind side; lower jaw length 1.89-1.98, 1.93 on ocular side, 1.74-1.88, 1.82 on blind side; depth of caudal peduncle 2.70-3.29, 3.09; length of longest dorsal fin ray 1.68-1.89, 1.80; length of third dorsal fin ray 1.07-2.33, 1.64 in males, 2.66 in a female; length of longest anal fin ray 1.73-1.83, 1.77; pectoral fin length 1.46-1.66, 1.57 on ocular side, 3.04-3.73, 3.38 on blind side; pelvic fin length 3.00-3.21, 3.10 on ocular side, 2.58-2.76, 2.76 on blind side; length of pelvic fin base 3.04-

Source : MNHN, Paris

3.35, 3.21 on ocular side, 8.28-9.08, 8.59 on blind side; length of middle caudal fin ray 1.28-1.39, 1.34; lateral line curve width 1.98-2.21, 2.09.

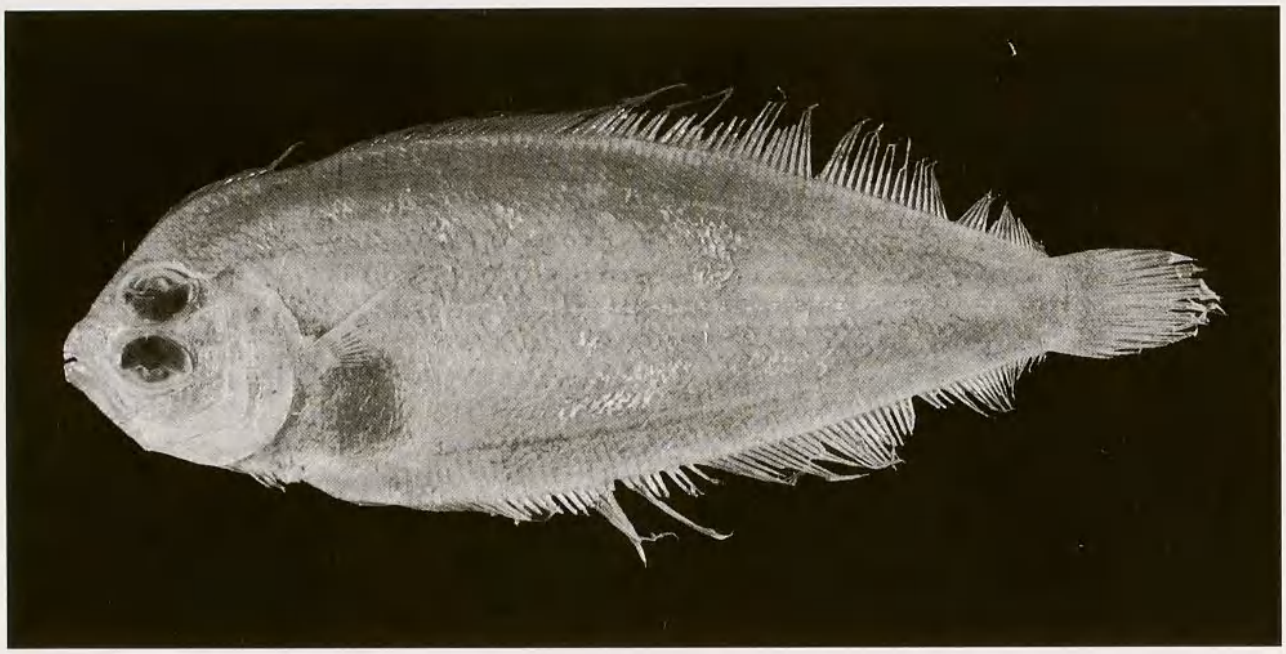

FIG. 11. — *Arnoglossus elongatus* Weber, 1913, male, 98.8 mm SL, from off north of New Caledonia (HUMZ 142676).

Body elongated, elliptical, deepest slightly anterior to midpoint; dorsal and ventral contours gently arched. Caudal peduncle depth 21.9-24.7 % of body depth. Head large; upper profile with a slight notch anterior to upper eye. Snout long, length 59.0-77.3 % of upper eye diameter. Rostral and orbital spines absent. Eyes large, separated by narrow bony ridge; upper eye diameter 72.5-84.8 % of ocular side upper jaw length, lower eye in advance of upper. Ocular side nostrils anterior to dorsal margin of lower eye; anterior nostril tubular with a flap posteriorly; blind side nostrils small, near dorsal fin origin, similar in shape to those on ocular side.

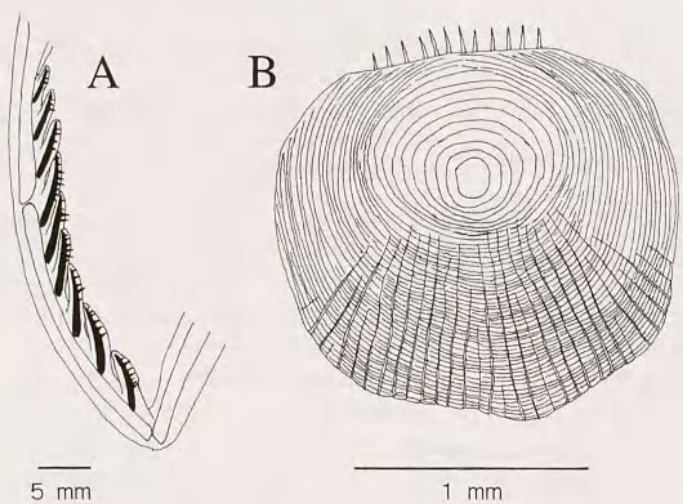

FIG. 12. — First gill arch (A) and a scale (B) from ocular side of *Arnoglossus elongatus* Weber, 1913, female, 84.5 mm SL (HUMZ 142677).

Mouth large, weakly curved obliquely; maxilla extending to below anterior part of lower eye; anterior tips of both jaws nearly on same vertical line when mouth closed. Small knob at mandibular symphysis. Dentition more or less equally developed on both jaws; teeth on upper jaw sharp, uniserial, becoming larger and more widely spaced anteriorly; lower jaw teeth small and close-set. Gill rakers on first arch moderate in size, serrated (Fig. 12A). Ocular side scales large; with short ctenii (Fig. 12B) except those on anterior lateral line and around pectoral fin base; snout, upper jaw, anterior parts of lower jaw, and interorbital region naked; cycloid scales on blind side. Lateral line curved above pectoral fin on ocular side, lateral line absent on blind side.

Dorsal fin origin on blind side, anterior to interorbital region; second and third, sometimes

Source : MNHN, Paris

fourth rays elongated more than adjacent rays in both sexes; third ray in males longer than that in females (Fig. 13). Anal fin origin equal with vertical through posterior margin of head. Pectoral fins unequal; length of ocular side fin 1.90-2.47 times that of blind side, much less than head length. Pelvic fins with 6 rays, origin of ocular side fin at tip of isthmus; base of ocular side fin longer than that of blind side; fourth ray of ocular side fin opposite first ray of blind side fin. Tip of isthmus at a point equal with vertical through posterior part of lower eye. All fin rays simple, except caudal fin rays. Caudal fin rays bifurcated, except upper- and lowermost three simple rays.

TABLE 7. — Frequency distributions of selected meristic characters of *Arnoglossus elongatus*. Counts from blind side shown in parentheses.

Dorsal fin rays						Anal fin rays				Pectoral fin rays				
104	105	106	107	108	109	82	83	84	85	10	11	12	13	14
1	2	1	0	1	1	2	2	1	1	0(1)	0(5)	0(0)	4(0)	2(0)

Caudal fin rays	Scales in lateral line							Gill rakers		Vertebrae		
3 + 11 + 3	74	75	76	77	78	79	80	0+8	0+9	11+32	11+33	11+34
6	1	1	0	1	2	0	1	2	4	1	1	4

TABLE 8. — Proportional measurements as percent of standard length in *Arnoglossus elongatus*, including syntype. O, ocular side; B, blind side.

Character	Present specimens			Syntype
	Range 5 ♂, 1 ♀	Average	SD	♂
SL (mm)	66.4-98.8	84.3	11.8	75.0
Head length	24.3-25.9	25.3	0.5	26.7
Body depth	31.8-37.5	35.4	1.9	36.1
Snout length	5.0-6.0	5.3	0.3	5.6
Upper eye diameter	7.6-8.9	8.2	0.4	9.2
Lower eye diameter	7.5-8.9	8.2	0.4	9.1
Interorbital width	0.5-0.9	0.7	0.1	0.5
Upper jaw length (O)	9.5-10.8	10.4	0.4	10.7
Upper jaw length (B)	10.2-11.6	11.1	0.5	11.3
Lower jaw length (O)	12.2-13.5	13.1	0.4	13.6
Lower jaw length (B)	13.0-14.6	14.0	0.5	14.7
Caudal peduncle depth	7.7-9.0	8.2	0.4	7.9
Pectoral fin length (O)	15.2-17.4	16.2	0.9	-
Pectoral fin length (B)	6.8-8.1	7.5	0.5	-
Pelvic fin length (O)	7.9-8.5	8.2	0.2	8.7
Pelvic fin length (B)	8.9-9.9	9.4	0.3	9.3
Pelvic fin base length (O)	7.7-8.2	7.9	0.2	7.6
Pelvic fin base length (B)	2.8-3.1	3.0	0.1	3.1
Longest dorsal fin ray*	13.4-15.1	14.2	0.6	14.0
3rd dorsal fin ray (♂)	10.8-23.7	16.8	5.1	24.0
3rd dorsal fin ray (♀)	9.7	9.7	-	-
Longest anal fin ray	13.9-14.9	14.4	0.4	-
Middle caudal fin ray	18.1-19.9	19.0	0.6	-
Lateral line curve width	11.4-13.0	12.3	0.6	11.3

* except 3rd dorsal fin ray

Source : MNHN, Paris

Vent on blind side, immediately dorsal to first anal fin ray. Urogenital papilla on ocular side, opposite side of vent.

Coloration in alcohol: Ocular side ground color light brown; a few obscure dark spots on lateral line. Blind side uniformly pale brown. Dorsal and anal fins with series of obscure dark blotches; males with a dark band on distal margin of dorsal fin, from region above posterior part of head to middle of body (Fig. 13); caudal fin with a pair of obscure dark spots proximally.

Sexual dimorphism: This species shows sexual dimorphism in lengths of the anterior elongated dorsal fin rays and dorsal fin coloration (Fig. 13).

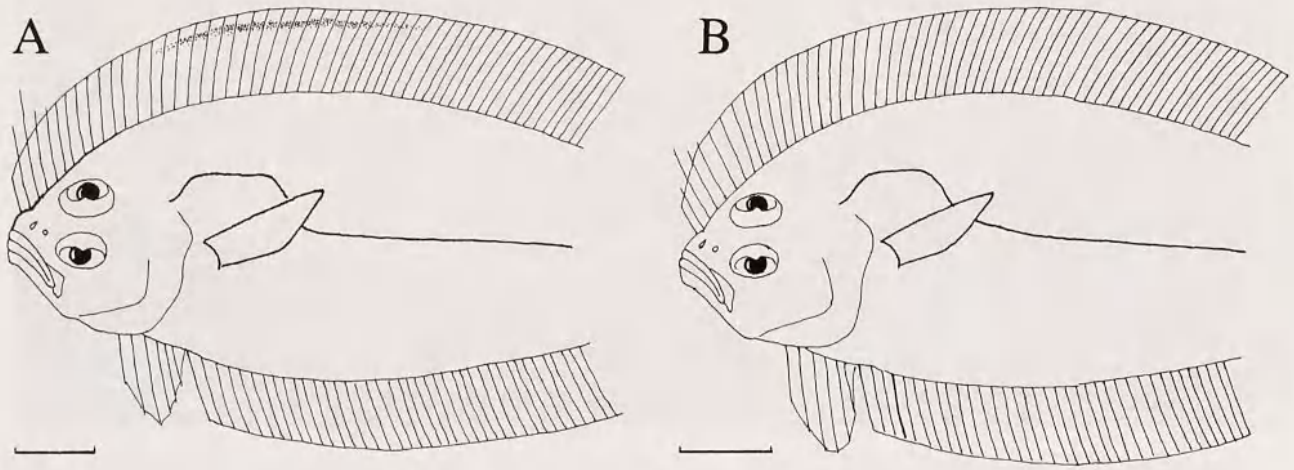

FIG. 13. — Diagrammatic illustration of anterior body parts showing sexual dimorphism in male (A) and female (B) *Arnoglossus elongatus*. Scale bars = 10 mm.

DISTRIBUTION. — Indonesia: Madura Sea (WEBER, 1913), northwestern Australia (GLOEFELT-TARP & KAILOLA, 1984) and New Caledonia, in depths of 100-350 m.

REMARKS. — This species very closely resembles *A. yamanakai* Fukui, Yamada & Ozawa, 1988, in having bifurcated middle caudal fin rays and a dark band in males on the distal margin of the dorsal fin (Fig. 13). However, this species differs from *A. yamanakai* in having several elongated anterior dorsal fin rays in both sexes (Fig. 13) (vs. only second ray elongated and only in males), a higher number of lateral line scales (74-80 vs. 63-68), larger eyes (upper eye diameter 2.92-3.30 in head length vs. 3.31-3.92 in adult specimens, lower eye diameter 2.92-3.25 vs. 3.31-3.95), and longer dorsal (1.68-1.89 vs. 2.02-2.47) and anal fin rays (1.73-1.83 vs. 2.02-2.48).

Arnoglossus elongatus also resembles *A. polyspilus* in having several elongated anterior dorsal fin rays and with the upper head profile rounded. It differs from the latter in the bifurcated middle caudal fin rays (vs. middle caudal fin rays with more than two branches) and its longer dorsal fin ray (1.68-1.89 in head length vs. 2.00-2.70).

This is the first record of *A. elongatus* from waters off New Caledonia.

Arnoglossus tenuis Günther, 1880

Figs 14-15; Tables 9-10

Arnoglossus tenuis Günther, 1880: 55. — JORDAN & SEALE, 1905: 528. — JORDAN & HUBBS, 1925: 295. — WU, 1932: 89. — NORMAN, 1934: 187, fig. 134. — FOWLER, 1934: 64. — WU & TANG, 1935: 392. — OKADA & MATSUBARA, 1938: 421; 1955: 1257. — KUROMUMA, 1940: 213. — KURODA, 1951: 388. — ZHENG, 1963: 970, fig. 755. — ZANG & WANG, 1963: 517, fig. 385. — SHEN, 1966: 176, figs 39-41; 1983: 27, fig. 39. — AMAOKA, 1969: 188, 386, figs 74-75; 1974: 153, figs 1-2; 1984: 335, pl. 369-C. — NAKABO, 1993: 1172, 387, 1 fig.

Scidorhombus pallidus Tanaka, 1915: 567. — MATSUBARA, 1955: 1255.

Arnoglossus aspilos - CHEN & WENG, 1965: 41, fig. 26 (not *Rhombus aspilos* Bleeker, 1851).

Source : MNHN, Paris

MATERIAL EXAMINED. — 32 specimens (16 males and 16 females).

New Caledonia. Baie de Saint Vincent: 22°04.9'S, 166°05.2'E, 13 m, otter trawl (shrimps), 20.08.1985: 2 ♂ and 1 ♀, 61.7-77.9 mm SL (MNHN 1995-1108 to 1110); 1 ♂ and 1 ♀, 66.0-78.9 mm SL (HUMZ 142659-142660). — 21°58.5'S, 166°01.0'E, 10 m, otter trawl (shrimps), 18.10.1989: 4 ♂ and 4 ♀, 62.7-68.8 mm SL (MNHN 1995-1114 to 1121); 1 ♀, 59.1 mm SL (HUMZ 142662). — 21°58.5'S, 166°01.0'E, 10 m, otter trawl (shrimps), 21.11.1989: 3 ♀, 57.1-60.0 mm SL (MNHN 1995-1111 to 1113); 1 ♂, 64.6 mm SL (HUMZ 142661).

LAGON: stn 967, 20°21.6'S, 164°06.7'E, 12-16 m, beam trawl, 29.04.1988: 7 ♂ and 4 f♀, 49.2-60.8 mm SL (MNHN 1995-1122 to 1132); 1 ♂ and 2 ♀, 46.6-54.2 mm SL (HUMZ 142663-142665).

DIAGNOSIS. — Body shallow, depth 2.43-2.87 in SL; ocular side pelvic fin blackish, except basal portion in males; dorsal fin rays 84-94; anal fin rays 63-71; lateral line scales 54-59.

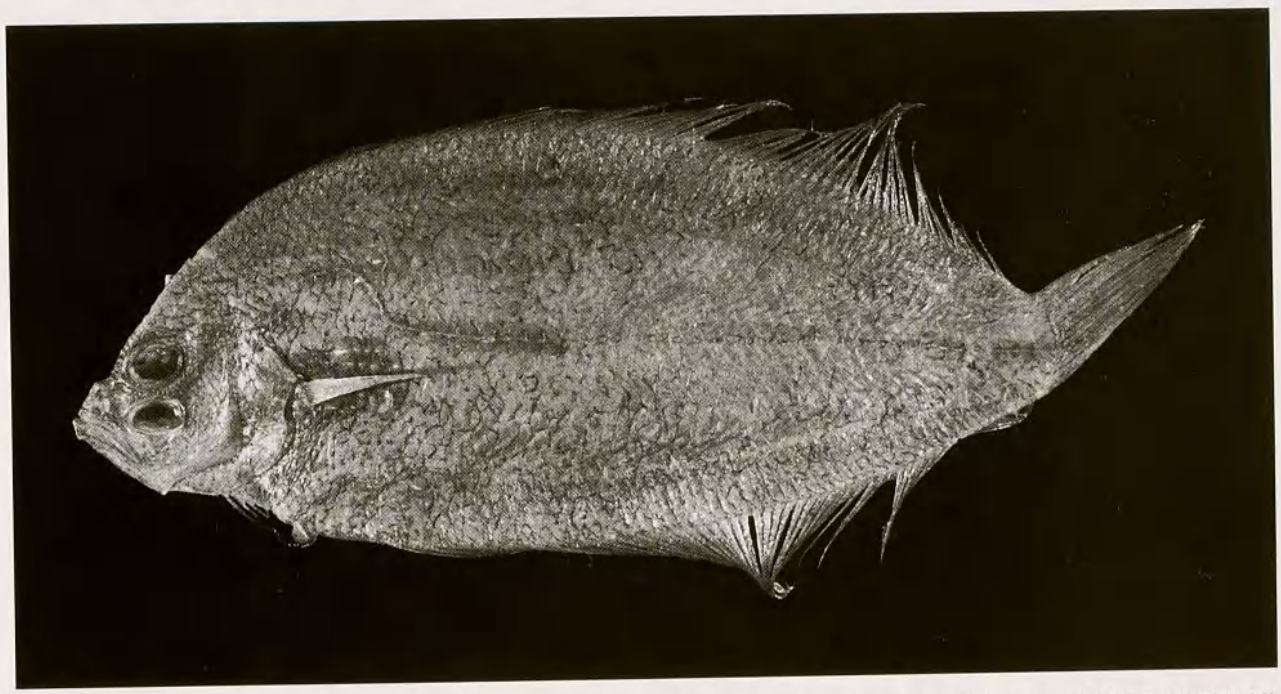

FIG. 14. — *Arnoglossus tenuis* Günther, 1880, male, 77.9 mm SL, from off southern New Caledonia (MNHN 1995-1109).

DESCRIPTION. — Ranges for proportional data given first, followed by averages. Counts and proportional measurements as percent of SL shown in Tables 9 and 10.

Head length 3.86-4.61, 4.09 in SL; body depth 2.43-2.87, 2.64. Snout length 4.38-5.28, 4.78 in head length; upper eye diameter 3.57-4.28, 4.01; lower eye diameter 3.71-4.52, 4.08; interorbital width 19.67-56.00, 36.51; upper jaw length 2.42-2.85, 2.61 on ocular side, 2.56-2.96, 2.80 on blind side; lower jaw length 1.90-2.10, 1.99 on ocular side, 1.97-2.25, 2.10 on blind side; depth of caudal peduncle 2.08-2.72, 2.43; length of longest dorsal fin ray 1.45-1.85, 1.63; length of longest anal fin ray 1.42-1.71, 1.59; pectoral fin length 1.52-1.80, 1.68 on ocular side, 2.18-2.75, 2.46 on blind side; pelvic fin length 2.29-2.89, 2.64 on ocular side in males, 2.74-3.41, 3.05 in females, 2.57-3.41, 3.10 on blind side; length of pelvic fin base 3.16-4.05, 3.60 on ocular side, 6.04-9.85, 8.38 on blind side; length of middle caudal fin ray 1.10-1.29, 1.20; lateral line curve width 1.65-2.03, 1.84.

Body elongated, elliptical, deepest at midpoint; dorsal contour strongly arched, ventral one weakly arched. Caudal peduncle depth 24.5-29.6 % of body depth. Head small; a large notch anterior to upper eye. Snout short, length 68.2-95.1 % of upper eye diameter. Rostral and orbital spines absent. Eyes small, separated by narrow bony ridge, upper eye diameter 60.0-73.3 % of upper jaw length; lower eye slightly in advance of upper. Ocular side nostrils anterior to interorbital area; ocular side anterior nostril tubular with a flap posteriorly; blind side nostrils small, ventral to dorsal origin, similar in shape to those on ocular side.

Mouth large, oblique; maxilla extending to below or slightly beyond anterior margin of lower eye; anterior tip of lower jaw projecting slightly in advance of tip of upper jaw when mouth closed. Small ventrally directed knob

Source : MNHN, Paris

at mandibular symphysis. Dentition more or less equally developed on both jaws; upper jaw teeth sharp, uniserial; lower jaw teeth uniserial, nearly equal to middle teeth of upper jaw in size and spacing. Gill rakers on first arch slender, not serrated, absent on upper limb. Scales large, deciduous, with short ctenii on ocular side, cycloid on blind side. Lateral line curved above pectoral fin on ocular side; lateral line absent on blind side.

Dorsal fin origin on blind side, anterior to ventral margin of upper eye. Anal fin origin at a point equal with vertical through pectoral fin base. Pectoral fins unequal, length of ocular side fin 1.31-1.64 times that of blind side. Pelvic fins with 6 rays; ocular side pelvic fin slightly longer in males than in females (Fig. 15); approximately fourth ray of ocular side fin opposite first ray of blind side fin. Tip of isthmus posterior to and ventral to lower eye. Most caudal fin rays with more than two branches, except upper- and lowermost three or four simple rays.

Vent on blind side, immediately dorsal to first anal fin ray. Urogenital papilla on ocular side, opposite side of vent.

Coloration in alcohol: Ocular side ground color dark brown; several obscure dark spots on lateral line. Blind side uniformly pale brown. Ocular side pelvic fin blackish, except basal portion in males; females with dark distal margin.

Sexual dimorphism: This species shows sexual dimorphism in length and coloration of the ocular side pelvic fin (Fig. 15).

DISTRIBUTION. — Distributed from the southern coast of Japan (JORDAN & HUBBS, 1925) to the South China Sea (GÜNTHER, 1880) and New Caledonia, in depths of 7-16 m.

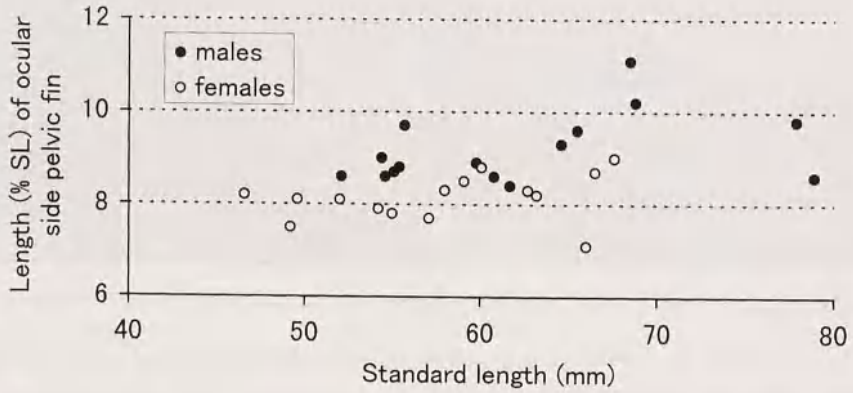

FIG. 15. — Relationship between SL and ocular side pelvic fin length in percent of SL in *Arnoglossus tenuis*.

TABLE 9. — Frequency distributions of selected meristic characters of *Arnoglossus tenuis*. Counts from blind side shown in parentheses.

Dorsal fin rays												Anal fin rays									Pectoral fin rays				
84	85	86	87	88	89	90	91	92	93	94		63	64	65	66	67	68	69	70	71	9	10	11	12	13
2	2	2	7	5	4	7	1	0	1	1		1	2	6	5	9	2	3	2	1	0(5)	2(20)	21(4)	7(1)	2(0)

Caudal fin rays				Scales in lateral line						Vertebrae		
3+11+3	3+11+4	3+10+4	4+10+3	54	55	56	57	58	59	10+29	10+30	10+31
29	1	1	1	7	3	11	4	3	4	10	21	1

Gill rakers											
0+8	0+9	1+8	1+9	1+10	2+8	2+9	2+10	3+8	3+9	3+10	4+8
6	4	2	6	1	3	3	1	2	2	1	1

Source : MNHN, Paris

TABLE 10. — Proportional measurements as percent of standard length in *Arnoglossus tenuis*. O, ocular side; B, blind side; M, males; F, females.

Character	Range 16 ♂, 16 ♀	Average	SD
SL (mm)	46.6-78.9	60.6	7.8
Head length	21.7-25.9	24.5	0.9
Body depth	34.8-41.1	38.0	1.7
Snout length	4.5-5.7	5.1	0.3
Upper eye diameter	5.2-6.8	6.1	0.4
Lower eye diameter	5.1-6.8	6.0	0.4
Interorbital width	0.4-1.2	0.7	0.2
Upper jaw length (O)	8.4-10.3	9.4	0.4
Upper jaw length (B)	7.7-9.5	8.7	0.4
Lower jaw length (O)	11.3-13.1	12.3	0.5
Lower jaw length (B)	10.5-12.7	11.7	0.5
Caudal peduncle depth	9.3-10.9	10.1	0.4
Pectoral fin length (O)	13.3-15.9	14.6	0.6
Pectoral fin length (B)	8.5-11.7	10.0	0.6
Pelvic fin length (O, M)	8.4-11.1	9.2	0.7
Pelvic fin length (O, F)	7.1-9.0	8.1	0.5
Pelvic fin length (B)	7.0-9.1	7.9	0.5
Pelvic fin base length (O)	5.7-7.8	6.8	0.6
Pelvic fin base length (B)	2.4-4.0	3.0	0.4
Longest dorsal fin ray	13.4-16.5	15.0	0.6
Longest anal fin ray	14.5-16.6	15.4	0.5
Middle caudal fin ray	18.5-21.7	20.4	0.7
Lateral line curve width	12.7-15.3	13.4	0.7

REMARKS. — This species closely resembles *A. aspilos* in having a shallow body and relatively low number of lateral line scales, although the latter count is somewhat higher than that of *A. aspilos* (54-59 vs. 46-48) (NORMAN, 1934).

Sexual dimorphism has not previously been reported in this species. However, New Caledonian specimens showed sexual dimorphism in both the length and coloration of the ocular side pelvic fin.

This is the first record of *A. tenuis* from the Coral Sea.

Arnoglossus polyspilus (Günther, 1880)

Fig. 16; Tables 11-12

Anticitharus polyspilus Günther, 1880: 48, pl. 22, fig. A. — WEBER, 1913: 433.
Arnoglossus polyspilus - NORMAN, 1927: 20; 1934: 190, fig. 137. — OKADA & MATSUBARA, 1938: 421. — KAMOHARA, 1951: 6; 1952: 78; 1958: 62; 1964: 81. — MATSUBARA, 1955: 1257. — CHEN & WENG, 1965: 42, fig. 27. — AMAOKA, 1969: 191, figs 76-77. — SHEN, 1983: 29, fig. 40. — GLOEFELT-TARP & KAILOLA, 1984: 273, 358, 1 fig. — RIVATON, 1989: 145, 155, 163. — RIVATON & RICHER DE FORGES, 1990: 25, 60. — NAKABO, 1993: 1173, 1 fig. — KULBICKI, RANDALL & RIVATON, 1994: 37.
Bothus (Anticitharus) polyspilus - WEBER & BEAUFORT, 1929: 124.

MATERIAL EXAMINED. — 12 specimens (7 males and 5 females).

New Caledonia. MUSORSTOM 4: stn CP 192, 18°59.30'S, 163°25.00'E, 320 m, 19.09.1985: 2 ♂ and 2 ♀, 63.0-170.2 mm SL (MNHN 1995-1160 to 1163); 1 ♂, 66.0 mm SL (HUMZ 142674).

Source : MNHN, Paris

Loyalty Islands. MUSORSTOM 6: stn DW 392, Ouvea Island, 20°47.32'S, 167°04.60'E, 340 m, 13.02.1989: 1 ♀, 52.5 mm SL (HUMZ 142673). — Stn CP 409, Lifou Island, 20°41.05'S, 167°07.25'E, 385 m, 15.02.1989: 1 ♀, 167.9 mm SL (HUMZ 142672).

Chesterfield Plateau. CHALCAL 1: stn CP 4, 19°33.90'S, 158°37.90'E, 350-370 m, 16.07.1984: 1 ♀, 181.3 mm SL (MNHN 1995-1156). — Stn CP 5, 19°29.10'S, 158°37.63'E, 290 m, 16.07.1984: 3 ♂, 72.1-113.1 mm SL (MNHN 1995-1157 to 1159).

MUSORSTOM 5: stn DW 335, 20°03.24'S, 158°45.35'E, 315 m, 15.10.1986: 1 ♂, 171.0 mm SL (HUMZ 142675).

DIAGNOSIS. — Upper profile of head rounded; gill rakers with serrated margins; dorsal fin rays 109-116; anal fin rays 86-91.

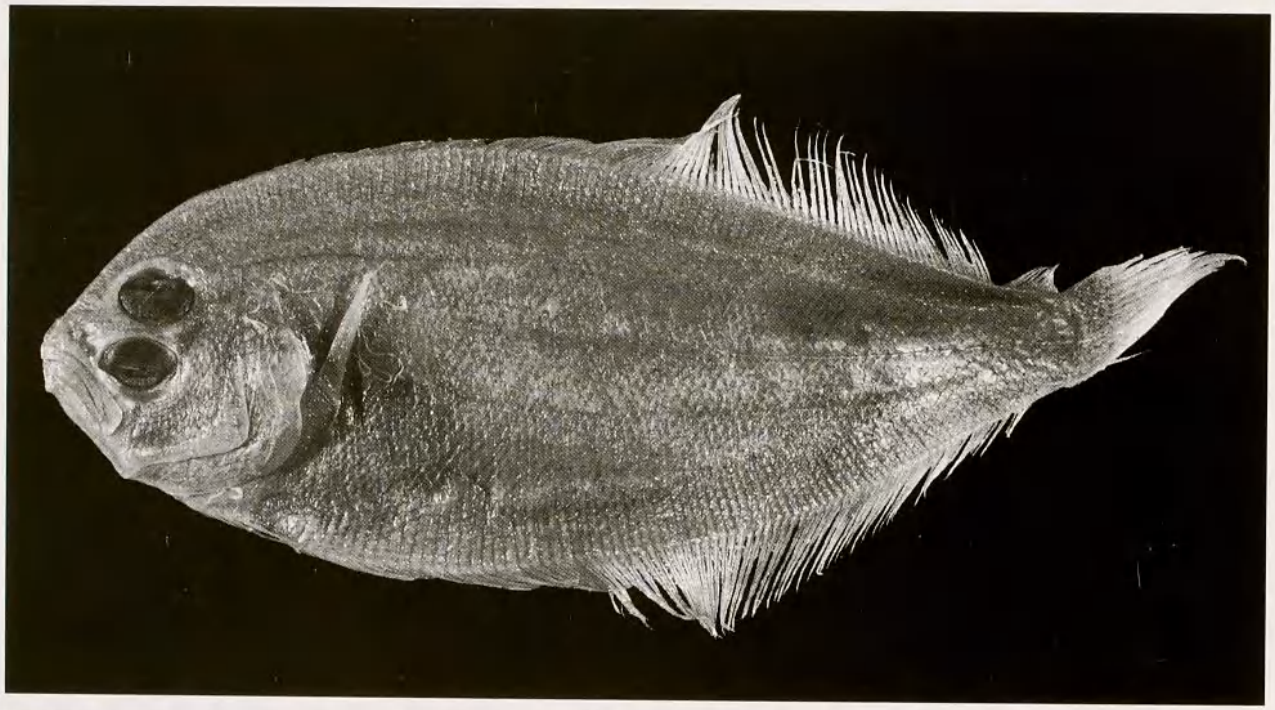

FIG. 16. — *Arnoglossus polyspilus* (Günther, 1880), female, 181.3 mm SL, from Chesterfield Plateau (MNHN 1995-1156).

DESCRIPTION. — Ranges for proportional data given first, followed by averages. Counts and proportional measurements as percent of SL shown in Tables 11 and 12.

Head length 3.57-4.05, 3.87 in SL; body depth 2.42-2.83, 2.64. Snout length 4.15-4.72, 4.46 in head length; upper eye diameter 2.95-4.08, 3.60; lower eye diameter 3.00-4.15, 3.64; interorbital width 22.55-41.50, 30.88; upper jaw length 2.31-2.62, 2.48 on ocular side, 2.18-2.50, 2.34 on blind side; lower jaw length 1.82-2.02, 1.93 on ocular side, 1.67-1.89, 1.78 on blind side; depth of caudal peduncle 2.58-3.00, 2.77; length of longest dorsal fin ray 2.00-2.22, 2.11; length of longest anal fin ray 1.85-2.19, 2.03; pectoral fin length 1.77-1.95, 1.83 on ocular side, 2.84-3.93, 3.41 on blind side; pelvic fin length 2.47-3.78, 3.24 on ocular side, 2.59-3.66, 3.17 on blind side; length of pelvic fin base 3.10-3.99, 3.49 on ocular side, 5.55-7.01, 6.24 on blind side; length of middle caudal fin ray 1.32-1.51, 1.42; lateral line curve width 1.48-1.87, 1.72.

Body elongated, elliptical, deepest slightly anterior to midpoint; dorsal contour more strongly arched than ventral one. Caudal peduncle depth 22.7-26.9 % of body depth. Head large; a slight notch anterior to ventral margin of upper eye. Snout long, length 64.5-96.2 % of upper eye diameter. Rostral and orbital spines absent. Eyes separated by narrow bony ridge, upper eye diameter 57.8-87.3 % of ocular side upper jaw length; lower eye slightly in advance of upper. Ocular side nostrils anterior to dorsal margin of lower eye, anterior nostril tubular with triangular flap posteriorly, and short flap anteriorly; blind side nostrils ventral to dorsal fin origin, anterior nostril tubular with short flap posteriorly.

Source : MNHN, Paris

Mouth large, oblique; maxilla extending to below anterior part of lower eye; anterior tips of both jaws nearly on same vertical line when mouth closed. Small ventrally directed knob at mandibular symphysis. Dentition about equally developed on both jaws; teeth on upper jaw sharp, uniserial, becoming larger and more widely spaced anteriorly; lower jaw teeth uniserial, similar to anterior teeth of upper jaw in size and spacing. Gill rakers on first arch moderate in size or slender, serrated, usually small rakers on upper limb. Scales large, deciduous, with short ctenii on ocular side, cycloid on blind side. Lateral line curved above pectoral fin on ocular side, lateral line absent on blind side.

TABLE 11. — Frequency distributions of selected meristic characters of *Arnoglossus polyspilus*. Counts from blind side shown in parentheses.

Dorsal fin rays								Anal fin rays						Pectoral fin rays					
109	110	111	112	113	114	115	116	86	87	88	89	90	91	9	10	11	12	13	14
1	5	1	1	2	0	1	1	1	1	5	1	3	1	0(2)	0(6)	0(3)	3(0)	8(0)	1(0)

Caudal fin rays		Scales in lateral line										Gill rakers						
2+13+2	2+12+2	70	71	72	73	74	75	76	77	78	79	80	0+7	0+8	0+9	1+8	1+9	2+8	2+9
11	1	1	0	2	0	0	1	2	2	2	1	1	1	1	1	6	1	1	1

Vertebrae		
10+30	10+31	10+32
1	7	4

TABLE 12. — Proportional measurements as percent of standard length in *Arnoglossus polyspilus*. O, ocular side; B, blind side.

Character	Range 7 ♂, 5 ♀	Average	SD
SL (mm)	52.5-181.3	108.6	48.0
Head length	24.7-28.0	25.9	0.9
Body depth	35.3-41.3	37.9	1.9
Snout length	5.3-6.2	5.8	0.3
Upper eye diameter	6.1-9.5	7.3	1.0
Lower eye diameter	6.0-9.3	7.2	1.0
Interorbital width	0.6-1.2	0.9	0.2
Upper jaw length (O)	9.7-10.9	10.4	0.4
Upper jaw length (B)	10.0-11.6	11.0	0.5
Lower jaw length (O)	12.6-14.4	13.4	0.5
Lower jaw length (B)	13.6-15.4	14.6	0.5
Caudal peduncle depth	8.8-9.6	9.3	0.2
Pectoral fin length (O)	13.3-15.1	14.1	0.6
Pectoral fin length (B)	6.5-8.8	7.7	0.8
Pelvic fin length (O)	6.7-10.1	8.1	1.0
Pelvic fin length (B)	6.8-9.5	8.3	0.7
Pelvic fin base length (O)	6.6-8.4	7.4	0.5
Pelvic fin base length (B)	3.7-4.7	4.2	0.3
Longest dorsal fin ray	11.8-12.6	12.2	0.3
Longest anal fin ray	11.9-14.1	12.9	0.7
Middle caudal fin ray	17.2-19.5	18.2	1.0
Lateral line curve width	14.3-16.7	15.1	0.8

Source : MNHN, Paris

Dorsal fin origin on blind side, anterior to ventral margin of upper eye; anterior 3-7 rays slightly elongated in some adult males, scarcely so in females and young males. Anal fin origin at vertical through posterior margin of head. Pectoral fins unequal, length of ocular side fin 1.61-2.22 times that of blind side. Pelvic fins with 6 rays; approximately third ray of ocular side fin opposite first ray of blind side fin. Tip of isthmus extending posterior to and ventral to lower eye. Caudal fin rays with more than two branches, except upper- and lowermost two simple rays.

Vent on blind side, immediately dorsal to first anal fin ray. Urogenital papilla on ocular side, opposite side of vent.

Coloration in alcohol: Ocular side ground color light brown. Blind side uniformly pale yellowish-white. Dorsal and anal fins with series of dark spots; caudal fin with a pair of obscure dark spots proximally.

Sexual dimorphism: This species shows sexual dimorphism in lengths of the third to seventh dorsal fin rays.

DISTRIBUTION. — Timor Sea (GÜNTHER, 1880), Kei Islands, Mergui Archipelago (NORMAN, 1927), south coast of Java (WEBER & BEAUFORT, 1929), southern coast of Japan (KAMOHARA, 1951), Taiwan (CHEN & WENG, 1965) and Coral Sea (RIVATON, 1989), in depths of 290-385 m in the Coral Sea and 90-252 m elsewhere.

REMARKS. — *Arnoglossus polyspilus* closely resembles *A. nigrifrons* sp. nov. in having the upper head profile rounded and in having large numbers of dorsal and anal fin rays, but differs from the latter as discussed in that species account (see below).

Arnoglossus nigrifrons sp. nov.

Figs 17-20; Tables 13-14

MATERIAL EXAMINED. — 3 specimens (1 male and 2 females).

New Caledonia. SMIB 6: stn DW 121, 18°57.08'S, 163°25.06'E, 315 m, 3.03.1990: 1 ♀, paratype, 45.9 mm SL (HUMZ 142678).

Chesterfield Plateau. CHALCAL 1: stn CP 5, 19°29.10'S, 158°37.63'E, 290 m, 16.07.1984: 1 ♀, damaged specimen (HUMZ 152143). — Stn CP 11, 20°04.40'S, 158°47.41'E, 300 m, 22.07.1984: 1 ♂, holotype, 119.8 mm SL (MNHN 1995-1168).

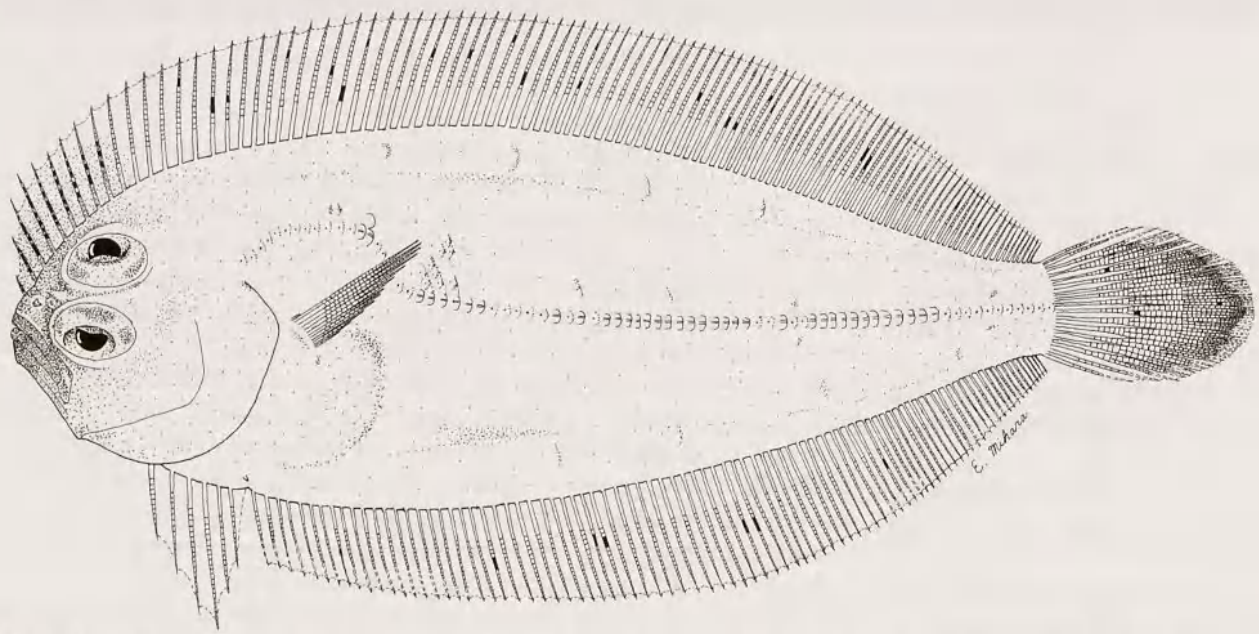

FIG. 17. — Illustration of *Arnoglossus nigrifrons* sp. nov., holotype, male, 119.8 mm SL, from Chesterfield Plateau, west of New Caledonia (MNHN 1995-1168).

Source : MNHN, Paris

TYPES. — *Holotype*: MNHN 1995-1168 (Chesterfield Plateau. CHALCAL 1, stn CP 11, 20°04.40'S, 158°47.41'E, 300 m).

Paratype: (HUMZ 142678 (New Caledonia. SMIB 6, stn DW 121, 18°57.08'S, 163°25.06'E, 315 m).

DIAGNOSIS. — Upper profile of head rounded, with a very slight notch anterior to interorbital region (Figs 17-18); anterior third to fifth rays of dorsal fin elongated more than adjacent rays in males; first to about tenth rays of dorsal fin, snout, both jaws and area in front of both eyes, and interorbital region darkened (Figs 17-18); gill rakers not serrated (Fig. 19A); dorsal fin rays 107-115; anal fin rays 88-91; scales in lateral line 79-83.

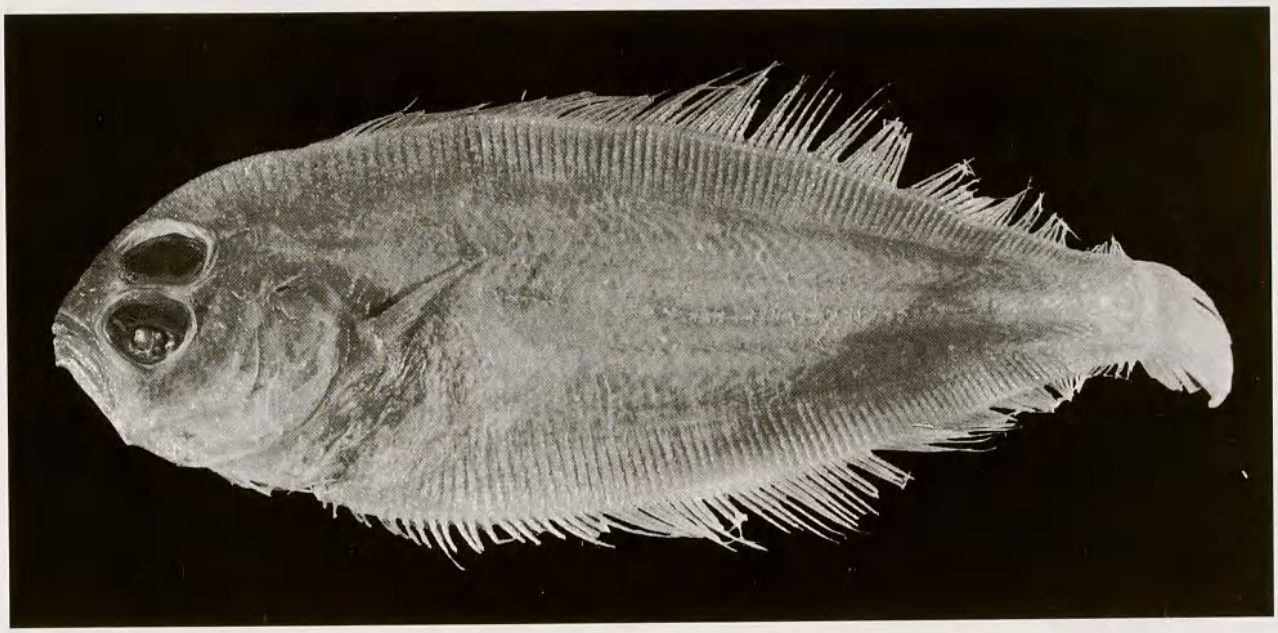

FIG. 18. — *Arnoglossus nigrifrons* sp. nov., holotype, male, 119.8 mm SL, from Chesterfield Plateau, west of New Caledonia (MNHN 1995-1168).

DESCRIPTION. — Data for holotype given first, followed in parentheses by proportional data for paratype. Counts and proportional measurements as percent of SL shown in Table 13.

Head length 3.88 (3.70) in SL; body depth 2.72 (2.98). Snout length 5.15 (4.96) in head length; upper eye diameter 3.22 (2.58); lower eye diameter 3.22 (2.95); interorbital width 30.90 (41.33); upper jaw length 2.58 (2.76) on ocular side, 2.60 (2.76) on blind side; lower jaw length 2.10 (2.10) on ocular side, 2.01 (1.94) on blind side; depth of caudal peduncle 2.97 (3.02); length of longest dorsal fin ray 2.24 (2.10); length of longest anal fin ray 2.07 (1.97); pectoral fin length 1.78 (2.07) on ocular side, 3.02 (-) on blind side; pelvic fin length 3.32 (3.26) on ocular side, 3.32 (3.44) on blind side; length of pelvic fin base 3.15 (4.13) on ocular side, 6.18 (6.89) on blind side; length of middle caudal fin ray - (1.43); lateral line curve width - (1.75).

Body elongated, elliptical, deepest slightly anterior to midpoint, depth 1.23-1.43 length of head; dorsal and ventral contours gently arched. Caudal peduncle depth 23.6-26.6 % of body depth. Head large; upper profile with a very slight notch anterior to interorbital region. Snout short, length 52.1-62.5 % of upper eye diameter. Rostral and orbital spines absent. Eyes large, separated by narrow bony ridge; upper eye diameter 80.0-106.7 % of ocular side upper jaw length, lower eye slightly in advance of upper. Ocular side nostrils anterior to dorsal margin of lower eye; anterior nostril tubular with a flap posteriorly; blind side nostrils small, ventral to dorsal fin origin, similar in shape to those on ocular side.

Mouth large, oblique; maxilla extending to below anterior part of lower eye; anterior tips of both jaws nearly on same vertical line when mouth closed. Dentition about equally developed on both jaws; upper jaw teeth sharp, uniserial, becoming larger and more widely spaced anteriorly, some anterior teeth canines; lower jaw teeth uniserial, similar to anterior teeth of upper jaw in size and spacing. Gill rakers on first arch moderate in size, not

Source : MNHN, Paris

serrated, absent on upper limb (Fig. 19A). Scales small, with short ctenii on ocular side (Fig. 19B), cycloid on blind side; snout, anterior parts of both jaws, areas in front of both eyes, and interorbital region and pectoral fin naked. Lateral line curved above ocular side pectoral fin; lateral line absent on blind side.

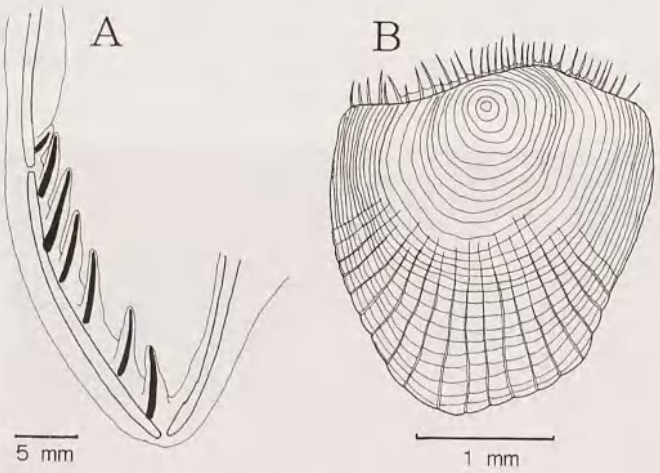

FIG. 19. — First gill arch (A) and a scale (B) from ocular side of *Arnoglossus nigrifrons* sp. nov. (A: female, HUMZ 152143, 86.6 mm SL; B: holotype, male, 119.8 mm SL, MNHN 1995-1168).

Dorsal fin origin on blind side, anterior to interorbital region; anterior 3-5 rays elongated more than adjacent rays in male, not so in female (Fig. 20). Anal fin origin at vertical through posterior margin of head. Pectoral fins unequal, length of ocular side fin 1.71 times that of blind side, much less than head length. Pelvic fins with 6 rays, origin of ocular side fin at tip of isthmus, approximately third ray of ocular side fin opposite to first ray of blind side fin; base of ocular side fin longer than that on blind side. Tip of isthmus posterior to and ventral to lower eye. All fin rays simple, except caudal fin rays. Caudal fin rays with more than two branches, except upper- and lowermost two simple rays.

Vent on blind side, immediately dorsal to first anal fin ray. Urogenital papilla on ocular side, opposite side of vent.

Coloration in alcohol: Ocular side ground color pale brown; snout, both jaws, and area in front of eyes, and interorbital region darkened; a few obscure dark spots on lateral line. Blind side uniformly pale brown. Dorsal fin darkened anteriorly for about ten rays; dorsal and anal fins with series of obscure dark blotches.

Sexual dimorphism: This species shows sexual dimorphism in lengths of the anterior third to fifth dorsal fin rays (Fig. 20).

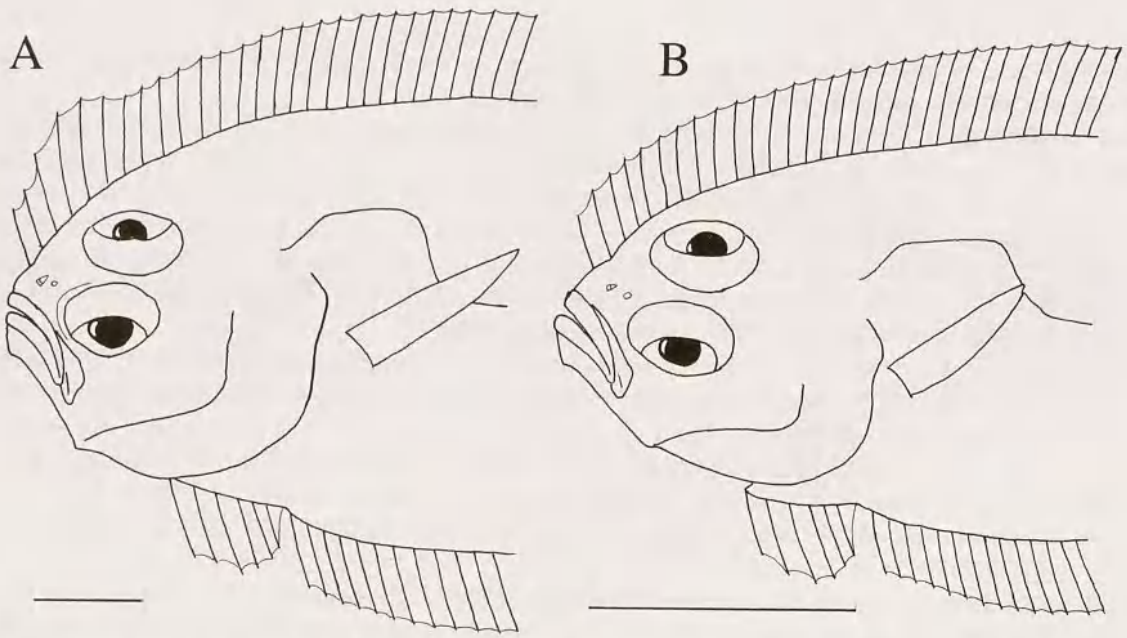

FIG. 20. — Diagrammatic illustration of anterior body parts showing sexual dimorphism in male (A) and female (B) *Arnoglossus nigrifrons* sp. nov. Scale bars = 10 mm.

Source : MNHN, Paris

DISTRIBUTION. — The specimens were collected from the Chesterfield Plateau and northwest of New Caledonia, in depths of 290-315 m.

ETYMOLOGY. — Named for the darkened areas on the head and anterior dorsal fin rays.

TABLE 13. — Proportional measurements as percent of standard length and counts of selected characters for *Arnoglossus nigrifrons* sp. nov. O, ocular side; B, blind side.

Character	Holotype ♂	Paratype ♀
SL (mm)	119.8	45.9
Proportions:		
Head length	25.8	27.0
Body depth	36.8	33.6
Snout length	5.0	5.4
Upper eye diameter	8.0	10.5
Lower eye diameter	8.0	9.2
Interorbital width	0.8	0.7
Upper jaw length (O)	10.0	9.8
Upper jaw length (B)	9.9	9.8
Lower jaw length (O)	12.3	12.9
Lower jaw length (B)	12.9	13.9
Caudal peduncle depth	8.7	8.9
Pectoral fin length (O)	14.5	13.1
Pectoral fin length (B)	8.5	-
Pelvic fin length (O)	7.8	8.3
Pelvic fin length (B)	7.8	7.8
Pelvic fin base length (O)	8.2	6.5
Pelvic fin base length (B)	4.2	3.9
Longest dorsal fin ray	11.5	12.9
Longest anal fin ray	12.4	13.7
Middle caudal fin ray	-	19.0
Lateral line curve width	-	15.5
Counts:		
Dorsal fin rays	107	115
Anal fin rays	88	91
Pectoral fin rays (O)	13	14
Pectoral fin rays (B)	10	11
Pelvic fin rays (O)	6	6
Pelvic fin rays (B)	6	6
Caudal fin rays	2+13+2	2+13+2
Scales in lateral line	79	83
Gill rakers	0+8	0+8
Vertebrae	10+33	10+32

REMARKS. — *Arnoglossus nigrifrons* sp. nov. closely resembles *A. polyspilus* (Günther, 1880) and *A. capensis* Boulenger, 1898, in having several somewhat elongated anterior dorsal fin rays in the males and with the upper head profile rounded with a very slight notch, but differs from both by the darker coloration of the anterior dorsal fin, snout, both jaws and the area anterior to the orbital region. It also clearly differs from *A. polyspilus* in having slender and elongate gill rakers without serrated margins (vs. strong and serrated gill

Source : MNHN, Paris

rakers) (Fig. 19A) (AMAOKA, 1969, fig. 77C) and a smaller lower jaw (Table 14), and from *A. capensis* in having a ridged and non-scaled interorbital region (vs. concave and scaled), larger numbers of dorsal and anal fin rays and lateral line scales, a smaller number of gill rakers, shallower body, larger upper eye and upper jaw, and shorter ocular side pectoral fin (Table 14) (NORMAN, 1934).

TABLE 14. — Comparison of proportional measurements and counts between *Arnoglossus nigrifrons* sp. nov., *A. polyspilus* and *A. capensis*.

	A. nigrifrons	*A. polyspilus*			*A. capensis*	
		present specimens	syntype	NORMAN (1934)	AMAOKA (1969)	NORMAN (1934)
No. of specimens	2	12	1	2	29	4
SL (mm)	45.9-119.8	52.5-181.3	190.0	180-220	98.0-203.0	125-170
Proportions:						
In SL:						
Body depth	2.72-2.98	2.42-2.83	2.76	2.66-2.75	2.45-2.72	2.25-2.40
In Head Length:						
Snout length	4.96-5.15	4.15-4.72	3.91	-	4.3-5.3	-
Upper eye diameter	2.58-3.22	2.95-4.08	4.20	-	3.12-3.97	3.33-4.0
Lower eye diameter	2.95-3.22	3.00-4.15	4.20	-	3.31-4.33	-
Upper jaw length (O)	2.58-2.76	2.31-2.62	2.40	2.25-2.60	2.30-2.60	3.00-3.25
Upper jaw length (B)	2.60-2.76	2.18-2.50	2.25	-	2.26-2.57	-
Lower jaw length (O)	2.10	1.82-2.02	1.97	-	1.88-2.02	1.83-2.33
Lower jaw length (B)	1.94-2.01	1.67-1.89	1.85	-	1.68-1.94	-
Pectoral fin length (O)	1.78-2.07	1.77-1.95	1.89	-	1.51-2.02	1.33-1.50
Counts:						
Dorsal fin rays	107-115	109-116	106	103-106	100-114	96-100
Anal fin rays	88-91	86-91	84	81-84	78-91	76-80
Pectoral fin rays (O)	13-14	12-14	12	11-12	11-13	11-12
Scales in lateral line	79-83	70-80	70	70-75	70-81	62-66
Gill rakers	0+8	0-2+7-9	1+10	?+8-9	1-2+8-9	?+10-13

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